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ABSTRACT

Presented are five instructional units, developed by the Tri-County Teacher Education Center, for the purpose of educating secondary school students on Florida's unique energy problems. Unit one provides a series of value clarification and awareness activities as an introduction to energy. Unit two uses mathematics exercises to examine energy consumption. Unit three, which focuses on basic competencies, teaches vocabulary, writing, reading, mathematics, map, and thinking skills through energy-related activities and problems. Unit four uses discussion, experimentation, role playing, and simulations to examine issues and teach problem solving, including such topics as hydrogen as a fuel, costs and benefits energy policies, air quality, and highway speeds. Included in unit five are devices which use different kinds of energy, activities for constructing a solar powered water heater, windmill, watt meter, and still. (DC)

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HIGHLANDS COUNTY

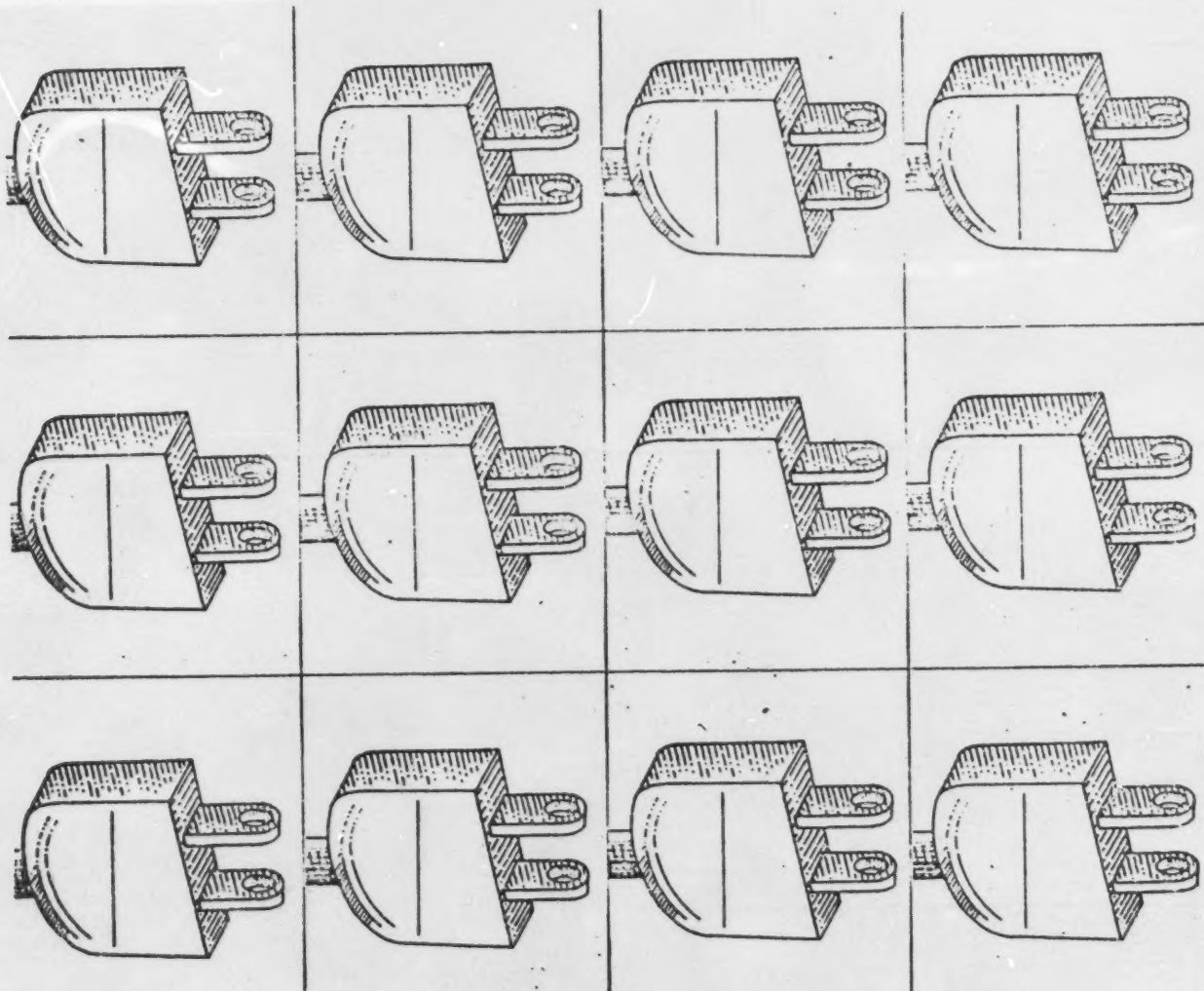
ENERGY EDUCATION ACTIVITIES

-HIGH SCHOOL LEVEL-

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INTRODUCTION

Perhaps the phrase "Energy Crisis", first introduced during the 1973 Arab Oil Embargo, is slightly misleading. The sun, for example, provides the world with 400 times more energy than we use each day. The unmined U.S. coal supply is large enough to meet demand in this country for years. Other forms of energy that man expects to better harness in the future such as the sea, wind, biomass and nuclear to name a few are not in short supply.

But, because man has become so dependent on the use of high quality fuels (petroleum and natural gas) which are rapidly being depleted, we now find ourselves in a crisis situation. Energy politics, higher costs and uncertainty over the future are the elements of this crisis. And, there is no simple way to be free of the problem.

Energy has been man's tool for advancement throughout his existence. Pre-historic man competed for the sun's energy with the other creatures in his environment. Survival meant relying on the sun to provide energy through plants and animals for food. The discovery of fire and crude tools increased man's chances for survival and provided him with a more secure position in the environment.

The stored solar energy released from wood by fire gave man a chance to expand his influence to other environments previously too hostile. Tools created a more efficient society by creating the first specialists: some members of early tribes were more adept at making the tools, others developed expertise at using the tools and still others taught their use.

The Agricultural Age

The next major energy breakthrough came in agriculture. By cultivating crops and domesticating animals for use in the fields, food could be dependably produced with less human energy. Agriculture also spawned new forms of specialization through the development of new tools for use in growing and harvesting. But, its effects were felt far beyond those early fields of corn and other grain.

Our written history began as a direct result of agriculture. Cities were built where centers of trade developed. As these cities were formed, more complex and more efficient forms of specialization began. Other forms of energy were employed as new demands of civilization called for them. Wind was harnessed by sailing ships for transportation and new uses for water in agriculture were found.

The agricultural age depended on renewable sources of energy; solar, wind and water. But, nearly 10,000 years after the birth of agriculture, man turned to other sources of energy, fossil fuels, to meet the new demands of the Industrial Revolution.

The Industrial Revolution

For most of the 19th century, the United States lagged behind England, the leader of the Industrial Revolution, so fossil fuels were not our most popular form of energy. As late as 1880, wood supplied 57 percent of the fuel consumed in this country. But, by 1900, as the United States began to emerge as a major force in the industrial world, coal was "King": supplying 71 percent of all the fuel consumed in the United States.

Florida's Energy

Florida's energy chain is a complex one. It begins with the sun and ends with nuclear-age power plants. The natural environment, which includes the sun, is responsible for the success of two of the state's top economic assets; agriculture and tourism. However, the energy generated by four nuclear plants accounts for 12 percent of the state's electricity.

Because much of Florida's economy revolves around services, other parts of the national economy--primarily processing, manufacturing and retailing--must remain strong to support it. Increasing energy costs and declines in the national economy are more likely to have a greater impact in Florida because much of our wealth depends on the affluence of others.

Since the nature of our economy is quite different from the nation as a whole, the ways we use our energy are also. The 1977 Florida Statistical Abstract ranks our energy use sectors as: 1. transportation (38 percent); 2. residential (23 percent); 3. commercial (19 percent); 4. industrial (14 percent); and 5. other (6 percent). While the national energy use sectors are ranked as: 1. industrial (40 percent); 2. transportation (31 percent); 3. commercial (18 percent); and 4. residential (11 percent).

Another difference between Florida and many other states is that nearly 90 percent of the state's direct energy uses, fuels and electricity, come from oil and natural gas. Virtually all of this is produced elsewhere and imported into the state. On the average, the United States depends on these two sources for about 75 percent of the total energy consumption...relying on coal and other sources to generate the remainder of the energy needed to meet the demand.

What Florida does have in common with the rest of the country is the need to adapt to the changing energy picture as smoothly as possible. Efficient use and conservation of energy offer a number of benefits to the individual, state and nation. Perhaps the most noticeable impact of oil and gas shortages on the U.S. economy is in the cost of these supplies. By placing a new important on efficiency and conservation that impact can be dramatically reduced.

For instance, many home experts have suggested that by keeping air-conditioning thermostats set at 78 degrees F. instead of 73 degrees cooling costs might be reduced by as much as 40 percent. Even a car pool of two persons can cut commuting costs in half.

There are many other ways to put our energy to a more profitable use and still maintain comfortable lifestyles and a healthy economy. But, we must investigate new ways to use conventional fuels, and be willing to adopt alternative resources whenever appropriate. In the past, man changed energy resources because the industrial age demanded different fuels than the agricultural age. In the future, we will have to move into still another energy age by knowing more about the types of energy available to us..and how they can best be used by each of us.

ENERGY PLANNING AND ENERGY EDUCATION

The Energy Element of Florida's comprehensive plan aims to develop, use wisely, and manage all forms of available energy in order to:

1. Achieve a high quality of life for all Floridians, including future generations; and
2. Sustain a long-term, stable and competitive state economy.

Six objectives have been selected to guide Florida's energy policy. They include:

- A. An adequate, flexible, reliable, economic, and environmentally sound future supply of energy to Florida.
- B. Development and promotion of the most effective and efficient use of all forms of energy available.
- C. Management of energy supplies and use consistent with environmental quality and the health, safety, social, and economic well-being of the public.
- D. Reduction of the vulnerability of Florida's economy to rising energy prices, interruptions of supply, and the future transition to alternative energy sources and patterns of energy use.
- E. Management and development of other physical, natural, economic, and human resources to avoid unnecessary long-term energy-intensive investments.
- F. Education of all citizens and decision-makers about energy issues and a coordinated process for their involvement in energy-related decisions.

Objective F has special implications for the educational community. Because of the complex and far-reaching nature of the energy situation, citizens must be aware of the problems and possible solutions. But opinion surveys continue to reveal that large segments of the public remain unconvinced that a serious energy problem exists. If citizens fail to perceive energy as a long-term problem, they are also unaware of the far-reaching economic and social implications that accompany the energy problem. This unfortunate attitude stems from a combination of factors including general distrust of government, partial information or misinformation, events of the moment (energy is available now), and past governmental efforts to isolate energy as a distinct technical issue without considering it as part of the "big picture."

Perhaps one of the most important roles of government and schools is to educate and inform citizens about the entire energy situation, furnish them with useful information which helps them cope with the situation, and finally provide them with a means of taking individual group action to improve the situation. When properly aware of the energy problem, citizens can assume individual responsibility for their actions and exert greater control over the choices being made.

Wayne H. Duncan, Director
Tri-County Teacher Education Center

I. INTRODUCTORY ACTIVITIES

Opinion Expressing

The leader asks various questions which are answered by raising or lowering of one hand. If a person wishes to pass, the arms are folded in front of him.

Ask such questions as: "How many of you feel your rooms are uncomfortably cold at school? At home?" "How many of you have changed the kind of clothes you wear indoors this winter?" "How many of you have your thermostats at 60° or less at night?" "How many of you or your parents have made energy conserving changes? Insulated? Plugged drafts? Used solar heat by controlling window drapes or shades?" "How many of you think the energy shortage is short-range? Contrived by government or utilities? Real and long-range?"

A variation of this strategy is the panel in which few members of the group indicate their opinions on the issues and share their discussion with the remainder of the group.

Rank Ordering

Number in order of importance your favorite method of transportation around town:

- _____ Carpool
- _____ Private car
- _____ Bicycle/moped
- _____ Bus
- _____ Walking

Questions for Discussion:

1. What are your reasons for choosing your particular favorite?
2. Which vehicle holds the fewest people; second fewest; third?
3. Which costs the most to run; second most; third?
4. Which costs the most to run, but holds the fewest people?
5. What does this tell you about your choice?

M. S. Torres

Imagining

How Would Your Life Be Different?

The students will think about and write on the following question:

"How would your life be different if there were no electricity?"
After this, the students' ideas can be shared in a group discussion.

Questions for Discussion:

1. What changes would it make in your life if there were no electricity?
2. Which of these changes would be the easiest to make? Which would be the hardest?
3. Are there changes that you could make now in your use of electricity?
4. What's stopping you from making these changes?

Rank Ordering

Number in order of importance to you the statements below:

- _____ Safety and health of our nation's citizens
- _____ Further development of our nuclear energy plants
- _____ Development of shale oil, coal, and natural gas
- _____ Protection of wildlife and the environment
- _____ Getting back to basics such as wind power and solar energy
- _____ Lack of dependence on foreign countries as fuel sources

1. Why are these issues important to us today?
2. Do you believe the priorities of most people are consistent with yours?

Lifestyle Inventory

Ask students to list 10 items that are considered indispensable to their present lifestyle. (You can invent a hypothetical disaster that would necessitate leaving home and taking along prized possessions, if you wish, e.g., what if the gas is turned off for two weeks and we have to leave.)

- _____ put an EL beside all those which plug into the wall
- _____ put a P beside those which are petroleum-based
- _____ put a C beside those you consider conveniences
- _____ put an L beside those you consider luxuries
- _____ put a PA beside those your parents would NOT have been able to use when they were your age
- _____ put an S beside those you can use only for yourself - do not (or cannot) share with others

ASK: Does anyone care to share some of their reactions? Did you gain any insights from this exercise?

Rank Ordering

Questions for Discussion:

1. If you were President, which would you give the highest priority?

_____ Defense
_____ Education
_____ Energy
_____ Economy

2. Which would you be least willing to give up to help alleviate the energy problem?

_____ Clean air
_____ The family automobile
_____ Government regulation of utility companies
_____ Safety from nuclear accident

Sample Discussion Questions:

1. How did you rank the issues in question #1, from the highest priority to the lowest? On question #2?
2. On what basis did you make your decision?

Chris Burton

Voting

The teacher reads aloud the following questions. After each question is read, the students take a position by a show of hands. Those who wish to answer in the affirmative raise their hands. Those who choose to answer negatively point their thumbs down. Those who are undecided fold their arms. And those who want to pass simply take no action at all. Discussion is tabled until the teacher has completed the entire list.

Each of the following questions should be prefaced by the statement, "How many of you....?"

Voting List

1. _____ would be willing to walk to the store or some other place you wanted to go, even if a ride were available?
2. _____ consciously try to save energy by turning your lights out when they're not needed?
3. _____ like to go for long car rides in the country?
4. _____ have ever taken the bus (or other public transportation) to a place you wanted to go in Tallahassee?
5. _____ have ever read a newspaper or magazine article about energy?

6. _____ would be willing to spend a summer without air conditioning?
7. _____ have spent an entire evening during the past week with neither the television nor stereo on?
8. _____ think that the energy crisis is real?

Questions for Discussion:

1. Are there places you would be willing to walk to, even if a ride were available?
2. In what ways would walking be desirable?
3. In what ways would walking be undesirable?
4. You mentioned "not being able to get someplace in a hurry." How do you feel about the pace of your own life?

Chris Burton

Stage A Debate

Investigate pros and cons of various energy sources. Have students play roles of utility representatives, citizens groups, government officials, business leaders. Apportion amounts of research money for the development of each source as a part of the exercise if you wish.

Priorities

Number in order of importance to you...

- ___ Health
- ___ Power
- ___ Conservation
- ___ Beauty
- ___ Wildlife
- ___ Independence
- ___ Peace
- ___ Fuel
- ___ Money
- ___ Comfort

1. Does each one of these issues concern us all in one way or another?
2. Do you think the order of importance changes as we grow older?
3. Have you changed your mind about many things as you have grown?
4. Take a look at your first three choices. Are they consistent with one another or do they conflict in some way?
5. Is it important that one's choices be consistent with others always or are there times when this isn't necessary?

M. S. Torres

CITIZENS AND ENERGY

Citizens in the United States, in Florida, and even in Highlands County have different ways of responding to problems. Think about the three citizen styles outlined below (Reactive, Proactive, and Inactive). Discuss how each might deal with the energy problem. What might they say and do about Governor Graham's "Save It, Florida" campaign? About the 55 mile per hour speed limit?

REACTIVE

PROACTIVE

INACTIVE

Voting Behavior	Votes <u>Against</u> Things	Votes <u>for</u> Things	Doesn't Vote
Information Seeking	Reads/listens to Popular Media	Seeks Information from many sources, including questioning leaders	Disbelieves Media and leaders
Attitude Toward Conflict	Avoids conflict, "must be provoked "	Provokes confrontation over issues	Avoids "trouble"
Attitude Toward Social Change	Worries about change, resists it, wants to return to the "good old days"	Seeks change as a means to solve social problems	Pessimistic about things getting better, does not exert self or participate in the change process
Participation Style	Watches Favorite TV Programs or joins "social clubs"	Starts or joins action groups and community organizations	Drops out

Seek and Find Energy

W	M	E	C	H	A	N	I	C	A	L	C	C	L	L	S	A	G
A	I	E	F	H	G	N	O	I	S	S	I	F	A	L	H	A	E
S	Y	N	F	U	E	L	I	I	J	R	L	C	C	E	S	K	O
U	T	B	D	S	H	A	L	E	T	L	M	A	I	C	E	L	T
N	T	U	T	M	D	E	T	C	O	A	L	L	R	R	T	A	H
U	F	S	G	K	I	N	E	T	I	C	V	O	T	A	A	I	E
C	F	O	S	S	I	L	F	U	E	L	S	R	C	L	L	T	R
L	H	L	I	J	E	K	L	L	M	N	O	I	E	O	U	N	M
E	G	A	S	O	H	O	L	I	G	H	T	E	L	S	S	E	A
A	P	R	R	E	N	E	W	A	B	L	E	O	E	R	N	T	L
R	A	D	I	O	A	C	T	I	V	E	P	F	U	S	I	O	N
N	Y	G	R	E	N	E	O	M	U	E	L	O	R	T	E	P	C
H	P	L	U	T	O	N	I	U	M	E	G	A	W	A	T	T	P

Answer the following questions, then, find the word in the puzzle.

1. A natural fuel such as coal, oil or natural gas
2. The ability to do work
3. British Thermal Unit
4. Unit of heat in metric system
5. Fossil fuel formed from fern forest
6. A form of energy that flows through wires
7. Energy of machines
8. Energy of motion
9. Energy, stored or by position
10. Shortened form of gasoline
11. A form of kinetic energy, measured in BTU or calories
12. Heat energy within the earth
13. The joining of two atoms
14. The splitting of an atom
15. Electric power produced by moving water
16. Electromagnetic radiation which can affect the eye

17. Atomic energy
18. Sedimentary rock that may contain oil
19. Flammable liquid mixture of hydrocarbon
20. Shortened form of #19
21. Synthetic gas, from coal
22. Grain alcohol (ethanol) mixed with gasoline
23. A device which converts solar energy into electrical energy
24. Energy directly from the sun
25. Old device that may provide energy
26. One way to help in the energy crisis
27. A unit of power equal to 1000 kilowatts
28. One way to save heat energy in the home
29. Wood and other plant material are considered resources
30. Material that gives off radiation
31. Nuclear fuel made from uranium

Answers for Teachers

- | | | |
|----------------|-------------------|------------------|
| 1. Fossil Fuel | 12. Geothermal | 23. Solar Cell |
| 2. Energy | 13. Fusion | 24. Solar |
| 3. B.T.U. | 14. Fission | 25. Windmill |
| 4. Calorie | 15. Hydroelectric | 26. Conservation |
| 5. Coal | 16. Light | 27. Megawatt |
| 6. Electrical | 17. Nuclear | 28. Insulate |
| 7. Mechanical | 18. Shale | 29. Renewable |
| 8. Kinetic | 19. Petroleum | 30. Radioactive |
| 9. Potential | 20. Oil | 31. Plutonium |
| 10. Gas | 21. Synfuel | |
| 11. Heat | 22. Gasohol | |

Conservation Survey

Read each of the following statements carefully. Each one suggests a way to encourage conservation of energy by Floridians.

Decide if you agree, disagree, or cannot make up your mind:

Place an A if you agree

Place a B if you disagree

Place a C if you cannot make up your mind

- ___ 1. Put the price freeze back on oil.
- ___ 2. Keep the price freeze off the oil.
- ___ 3. Close all stores on Sundays.
- ___ 4. Walk to school within a three mile area.
- ___ 5. Require more bicycles for all age groups.
- ___ 6. Close schools when weather is very cold (or very hot).
- ___ 7. Close off an area in school buildings during the summer months to save energy.
- ___ 8. Build more schools with windows available to all rooms.
- ___ 9. Have students alternate days of school - half on Monday, Wednesday, Friday; half on Tuesday, Thursday and Saturday. Alternate groups every other week.

- ___ 10. Cut out all boat and car races in the United States.
- ___ 11. Install solar water heaters in all new homes.
- ___ 12. Use coal instead of oil.

When finished, go back and give your reason why you agreed, disagreed, or why you cannot make up your mind.

Cleaning Up

1. How do you know when you are really saving energy and when you are using too much?
2. What forms of energy do you use directly?
3. What forms of energy do you need to clean clothes?
4. What forms of indirect energy are in the methods used everyday?
5. Compare the cost of using the home laundry and a public laundramat.

Compare the different ways people use energy, through washing and drying clothes, by hand and automatic (washer and dryer) gas and electric. Check with relatives and neighbors on which method they use.

Stepping Off Energy

2. Dry-outside	2. Dry-outside	2. Dry-outside	2. Automatic Dryer, Electric	2. Automatic Dryer, Gas
1. Washing Clothes- Hand-Hot H ₂ O	1. Automatic Washer- Electric, Hot H ₂ O	1. Automatic Washer- Gas, Hot H ₂ O	1. Automatic Washer, Electric Cold H ₂ O	1. Automatic Washer, Gas Cold H ₂ O

Cartoons

A picture says more than a thousand words. A cartoon sometimes says more. Have a bulletin board of energy connected cartoons. Have students collect them from home--or--have students produce their own.

II. ELECTRIC CONSUMPTION

HOW TO READ YOUR ELECTRIC METER

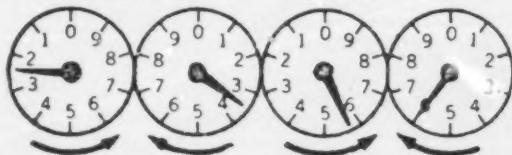


IF YOUR METER
LOOKS LIKE
← THIS

IF YOUR METER
LOOKS LIKE
THIS →



Reading from right to left, read each dial, writing down the last number which the hand has passed.



The above meter reads 2356.

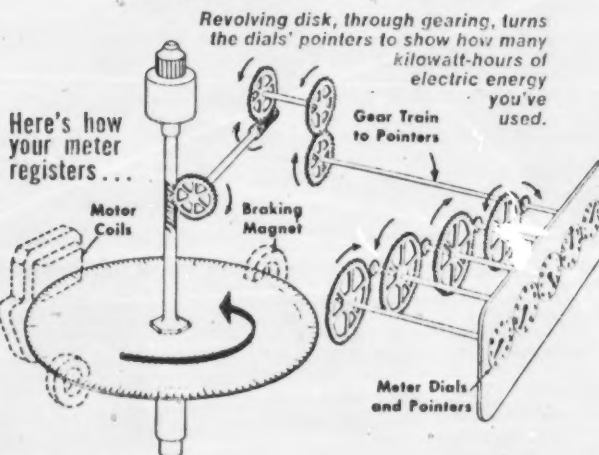
HERE'S HOW TO READ ABOVE

5	4	7	9
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Students might practice reading the school's meter, or an old meter might be obtained from the local utility company. Then, students might work with their parents to keep an accurate reading of household energy (electricity) use for one week. Students can compare electricity use.

How your meter works

Through the glass enclosure of your meter you can see a revolving disk and a series of dials and pointers. Here's a brief explanation of what goes on there.



This is a math conservation lesson, spanning a two week period. After a lesson on meter reading, students have an opportunity to apply their knowledge.

The first week they do nothing but read and record kilowatt hours from their meters at home. From this chart they do the various mathematical computations asked for from the questions.

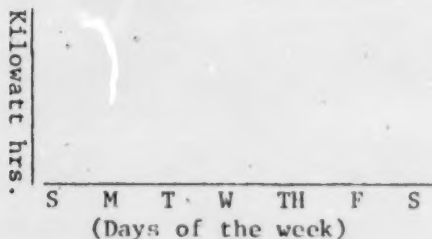
In the second week of keeping their kilowatt hours, they are asked to turn off the electric water heater for different periods of time. Two hours the first day, four hours the second day, six hours the third, eight or more hours the rest of the days. They then answer the same questions from the first week.

FIRST WEEK'S RECORD

Day of Week	Watt Hour Meter			Daily Consumption
	Start	Reading	Finish	

THINGS TO DO

1. Figure each day's consumption.
2. Which day did you consume the most?
3. Which day did you consume the least?
4. Make a line graph of the daily consumption.



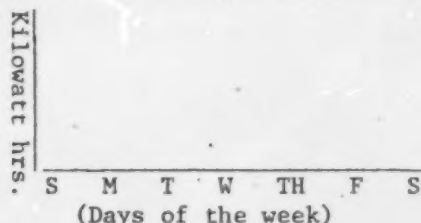
5. What was your weekly consumption?
6. Find the average consumption with three other students.

SECOND WEEK'S RECORD

Day of Week	Start	Watt Hour Meter Reading	Finish	Daily Consumption

THINGS TO DO

1. Figure each day's consumption.
2. Which day did you consume the most?
3. Which day did you consume the least?
4. Make a line graph of the daily consumption.



5. What was your weekly consumption?
6. Find the average consumption with the same three students from last week.

Let's Compare

Using Your Graphs

1. On which day and week did you consume the least electricity?
2. On which day and week did you consume the most electricity?
3. Did you consume more electricity on weekends or weekdays? Why?

Using Your Information

1. Compute the difference in daily consumption during the two weeks.
2. Compute the difference in weekly consumption.
3. Did turning the electric hot water heater off cause you to consume less electricity?
4. On which day do you begin to notice the difference in consumption from turning the electric water heater off?

5. If each kilowatt hour cost you \$.08, how much money, if any, did you save the second week?
6. What are other electrical appliances in your house that you could save on, if you used them less?

Set up your own energy conservation game at home. Record your watt-hour meter reading once a week. Try out different conservation measures and watch the results—lower weekly consumptions of electricity. Remember, the payoff in this game will be a reduced electric bill.

Date	Watt-Hour Meter Reading	Weekly Consumption

Which 3?

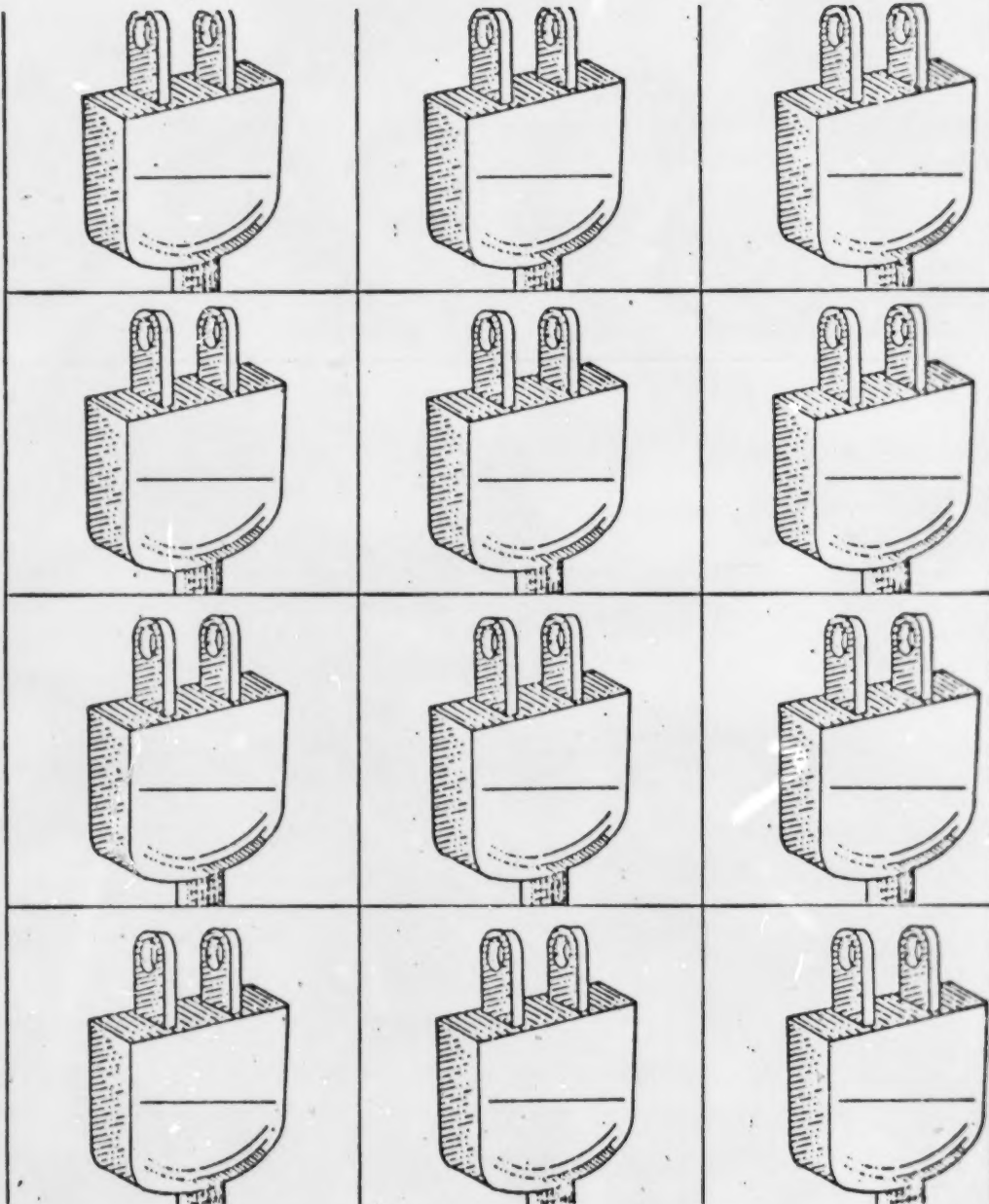
List 12 of your favorite items in your home that require electricity to operate.

1. If there were a decree which said you had to use less electricity, draw a pencil line through the three items you could really do without.
2. Circle in pencil the three that really mean the most to you and that you would hold on to until the very end.
3. Now look back over your list and your decisions and consider:
 - a. Why did you decide to do without the three items?
 - b. Why did you want to keep the other three?
 - c. Using information on the back of this sheet, determine how many kilowatt-hours and how much money you will need, based on Question 2.
4. Again based on Question 2, list below the efficiency steps you can take to reduce the kilowatt-hours and money consumed by each of the three appliances.

1 _____

2 _____

3 _____



Annual Electric Energy Use & Cost

A kWh (kilowatthour) is equivalent to the electricity used by ten 100-watt light bulbs burning for one hour.

	Average kWh Used Annually	Estimated Annual Cost at 2¢ kWh
Electric furnace	13,200*	\$264.00
Heat pump	6,600**	132.00
Quick recovery water heater	4,200	84.00
Clothes washer	1,900***	38.00
Refrigerator/freezer (14-cu. ft. frostless)	1,800	36.00
Freezer (15-cu. ft. frostless)	1,800	36.00
Dishwasher	1,560***	31.20
Air conditioning (Central, per ton)	1,500	30.00
Air conditioner (Room, one ton)	1,500	30.00
Freezer (15-cu. ft. manual defrost)	1,200	24.00
Refrigerator/freezer (14-cu. ft. manual defrost)	1,200	24.00
Range	1,200	24.00
Clothes dryer	1,000	20.00
Color television		
Tube type	660	13.20
Solid state	440	8.80
Dehumidifier	400	8.00
Black & white television		
Tube type	350	7.00
Solid state	120	2.40
Attic fan	300	6.00
Microwave oven	300	6.00
Roaster	200	4.00
Frying Pan	190	3.80
Electric blanket	150	3.00
Hand iron	150	3.00
Radio-phonograph	110	2.20
Coffeemaker	110	2.20
Trash compactor	50	1.00
Vacuum cleaner	50	1.00
Toaster	40	.80
Food disposer	30	.60
Sun lamp	20	.40
Clock	18	.36
Mixer	10	.20
Toothbrush	.5	.01

*Based on 1,500-sq. ft. fully insulated house located in a 3,500-degree-day area.

**Heat only.

***Includes kWh for heating water used in these appliances.

For further information, see your local power distributor.



TVA Power Marketing Division

Use
Electricity
WISELY

Find the cost of each energy user at the annual cost rate in your area.
(NOTE: The price figures printed on this sheet are based on \$.02 per kilowatt hour--a very low rate today!)

PROJECT: Compare the different amount of electricity used in a family home during three different times of the day.

PROCEDURE: Make a chart listing all appliances and other machines used in your home. Next to these record the number of watts for each separate appliance and machine. The times at which the data should be recorded are 7:00 a.m., 4:00 p.m. and 9:00 p.m. Place check marks indicating which of these are in use at each specified time. The project will last for a period of 7 days.

Appliances and Machines	Watts	Time of Day		
		7 a.m.	4 p.m.	7 p.m.
Watts Used				

Assignment:

1. At the end of each day, compute the watts used for each specified time.
2. Average the watts used for the 7 day period for each time.
3. What time of the day was the most electricity used in your home for this week?

Math Activity Involving Reading Electric Meters and Computing Electric Bills

After a class session of computing electric bills and reading electric meters, the teacher should then ask students to think of items which would use a great deal of electricity. If possible obtain the "Blue Box" from your science coordinator or an electric meter box from the Florida Power Corporation, Avon Park or Lake Placid. The Blue Box is designed to show the amount of money it would cost you to run different appliances. The figures are based upon 1976 standards, but one could simply take 20% of the figure on the lighted array and add it to that number. This machine is very good in showing the student the cost of different appliances. (The cost is an average.) The teacher could have each student bring in an item he/she would like to try. A good item for the teacher to use is the movie projector, because just plugging it in will cost money (for it has an instant start). When the projector

is turned on only for the sound, the cost will jump. And then when the motor is turned on, the cost soars even higher. When the lamp is on, the amount is yet higher! Many of our TV's have instant starts, which costs us money just plugging it into the wall socket!

III. ENERGY AND BASIC COMPETENCIES

Lesson 1: English

Objective: Student will be able to identify energy words and understand the meanings.

Procedure:

1. Dictionary: look up the meaning of each word.
2. Student will use words in sentences.
3. Student will put the words in alphabetical order.
4. Student will give the number of syllables in each word.
5. Student will write a synonym to as many of the "energy" words as he can.

Lesson 2: English

Objective: Students will learn ways to save energy.

1. Pre-writing activity: Using a prepared questionnaire survey - student will take this home to survey parents.
2. Writing topic: Ways to solve energy problems at home.
3. Post-writing activity: After class discussion, put results into a composition entitled, "Ways that I can save energy in my home."

Lesson 3: English

Objective: Student will be able to use energy words in a poem.

Procedure:

1. Create a poem.
2. Use cartoons from magazines or make their own pictures to illustrate the poem.

Lesson 4: English

Objective: Student will be able to read an article on energy and answer questions, and also make up questions to an article.

Procedure:

- A.
 1. Read an article.
 2. Answer prepared questions.
- B.
 1. Read an article.
 2. Student will make up questions to the article.

Follow-Up activity: Students will exchange articles and answer each others' questions.

Lesson 5: English

Objective: Student will be able to write a short paper.

Procedure: Using magazine or book sources, write a short paper on the history of at least one of the energy words.

Extra post-activities:

1. Read a prepared short story and list all the things that happened in the story which were "energy" activities.
2. Combine all of the essays and poems that students have done and put into a notebook.

Math Activity Involving Percents for Energy Quotient Test

Each student should be given a copy of Test your E.Q. and the teacher needs to discuss with the class the correct and incorrect answers. After the above has been done, have each student conduct a survey of perhaps 30 people and ask each the questions from the E.Q. test.

The following day each student can present his/her findings. For example, 10 out of the 30 questioned answered question #1 correctly. The teacher may then ask "What percent of the people questioned gave a correct response?" Answer: 10/30 or 33%. "What percent gave an incorrect response?" Answer: 20/30 or 66%. This can be carried out for the remainder of the test. The students could then discuss with their families what they had learned from the E.Q. test and thus improve the communities' awareness about Energy conservation. Chart that could be used by students when recording their data:

Question	Response A	Response B	Response C
1			
2			
3			
4			
5			
6			
7			
8			
9			

Indicate response with a check (✓) mark.

Test Your E.Q.*

Take this quiz to check your knowledge and understanding of energy-environment issues. When you have marked your answer, turn to page 24 to see how well you have done.

1.

How much of the energy used in gas stoves supplies the pilot lights?

- a. 10%
- b. 25%
- c. 50%



2. An incandescent lamp and a fluorescent lamp have the same light output: Which uses energy more efficiently?

- a. fluorescent
- b. incandescent
- c. both about the same efficiency

3. How many soft drink cans can be manufactured from recycled aluminum with the energy needed to make a single can from aluminum ore?

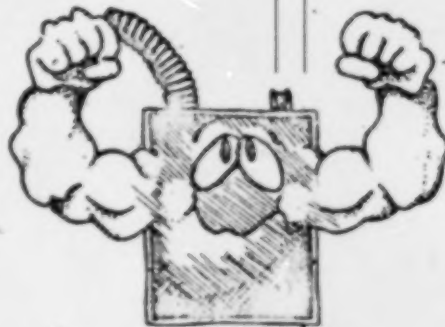
- a. three
- b. five
- c. twenty

4. How much heating oil would be saved on a typical winter day if the attics of single family homes that needed insulation were properly insulated?

- (a) 2%
- (b) 8%
- (c) 50%

5. How much of the energy stored in crude petroleum is lost between the oil well and a moving car?

- a. 20%
- b. 60%
- c. 90%

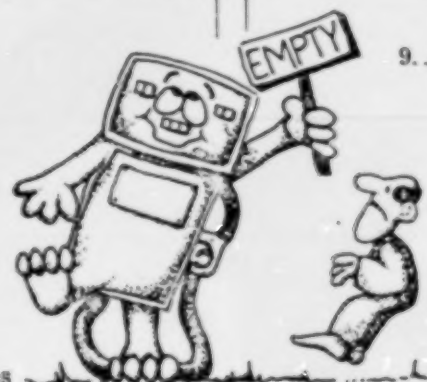


6. The heat energy of a gallon of gasoline is equivalent to

- a. 5 man-days of labor
- b. 15 man-days of labor
- c. 25 man-days of labor

7. How much faster than their rate of production are we consuming our fossil fuels?

- a. 10 times
- b. 1,000 times
- c. 1,000,000 times



8. What fraction of the world's energy consumption occurs in the U. S.?

- a. over 10%
- b. over 20%
- c. over 30%

9. Which of the following fuel resources is in greatest danger of exhaustion?

- a. coal
- b. petroleum
- c. natural gas

10. In the year 2000, American total energy demand will be:

- a. the same as today
- b. twice as much as today
- c. three times as much as today



Score 1 for each correct answer.
1—5 Poor, 6—7 Fair, 8—10 Good.

ANSWERS:

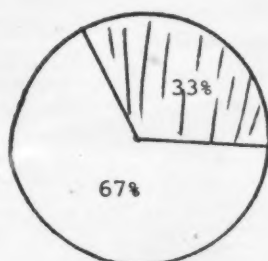
1. (c) Approximately half of the gas used in a gas stove is used to fuel the pilot lights because pilot lights burn continuously.
2. (a) Fluorescent lights give off three to four times as much light per watt of electricity used as incandescent lamps do. One 40-watt fluorescer light gives more light than *three* 60-watt incandescent bulbs (and the annual savings may be as much as \$10).
3. (c) Aluminum is a very energy intensive material with the largest share of the energy going to process the ore. Recycling is a great energy saver. The nation's total throwaway containers equivalent energy waste is equal to the output of 10 large nuclear power plants.
4. (b) If attic insulation were added to the 15 million single-family homes that need it, it would save about 8 percent of the heating oil previously used on a winter day.
5. (c) Ninety-four percent of the energy in the gasoline from crude petroleum is lost in making your car move. The efficiencies of the most important steps where energy is lost are:

producing the crude oil	96%
refining	87%
gasoline transport	97%
engine thermal efficiency	29%
engine mechanical efficiency	71%
rolling efficiency	30%
- The total efficiency of the system is found by multiplying the six factors together: 6%.
6. (b) 15 man-days of labor. Said in another way, one barrel of oil contains heat energy equivalent to the energy of a man at hard labor for 2 years.
7. (c) In less than 500 years man will have consumed essentially all of the coal, oil, and gas that nature started forming 500,000,000 years ago. By comparison, that same fraction of a calendar year is approximately 30 seconds.
8. (c) More than a third of the world's energy is consumed by the 6% of the world's population residing in the United States.
9. (c) Natural gas reserves in the U. S. are expected to be exhausted in about 40 years. Petroleum should last for a century. Coal, 500 years or so.
10. (b) For more than a century, American demand for energy has doubled, on the average, every 20-25 years.



Math Activity to Follow Percents for Energy Quotient Test - Involving Constructing Circular (Pie) Graphs.

Using the data collected for the activity which involved a survey of your energy quotient, the student may now learn how to construct circular (pie) graphs using a compass and protractor. Perhaps, if the student knows how to construct a circular (pie) graph, he/she will have a better understanding of these graphs and will be able to read them and interpret their results more efficiently. Example: Draw a circle using the compass. The student is told how many degrees there are in a circle (360°). He/she may then take a percentage of the entire circle. The answer would give him/her the number of degrees in that circle to represent that percentage. Using a protractor, the student can then measure off the appropriate degrees and shade this area. (33% of $360^\circ = .33 \times 360 = 118.8^\circ$ which is approximately 119° .)



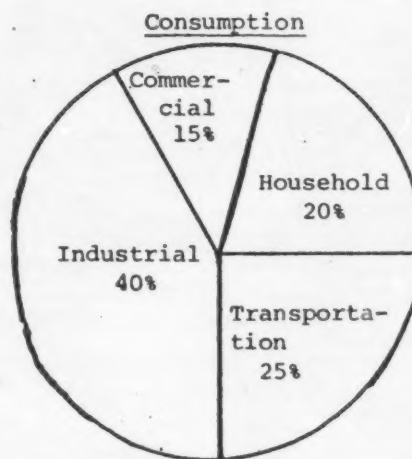
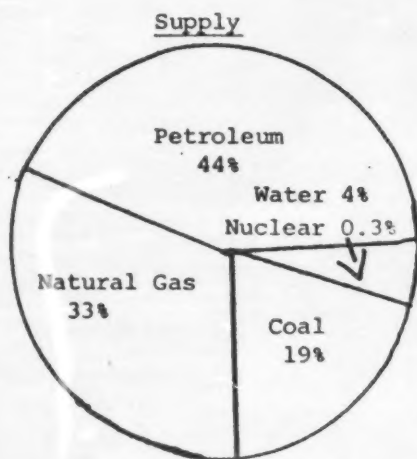
33% answered question #1 correctly.

67% answered question #1 incorrectly.

Perhaps the students' results could be placed on bulletin boards - and this may help people improve their energy awareness.

Percentages

In 1970, the energy consumption in the United States was 67,000 trillion BTU's. From the pie graphs below, determine the amount of energy used for each form of supply and consumption.



AFC Champion
Oakland Raiders
1980 Record: 11-5

27	Kansas City	14
24	San Diego	30
24	Washington	21
7	Bullalo	24
17	Kansas City	31
38	San Diego	24
45	Pittsburgh	34
33	Seattle	14
16	Miami	10
28	Cincinnati	17
19	Seattle	17
7	Philadelphia	10
9	Denver	3
13	Dallas	19
24	Denver	21
33	New York Giants	17
364		306

Defeated:	Houston	27 - 7
	Cleveland	14 - 12
	San Diego	34 - 27

Name each state the Oakland Raiders played in beside California. What other California team did they play?

1. How many miles do you think the Oakland Raiders traveled this football season?
2. Can you imagine how much fuel was used in their travel?
3. If you think the Raiders would use a great deal of fuel in a season, how would you feel about the amount of fuel all 20 professional football teams use in a season?

-- Anne McCullen

• Air conditioning and water heating are the top energy consumers in Florida homes: these uses consume a much higher percentage of total residential energy than in other states. Conversely, heating of Florida homes uses far less energy than the national average for heating.

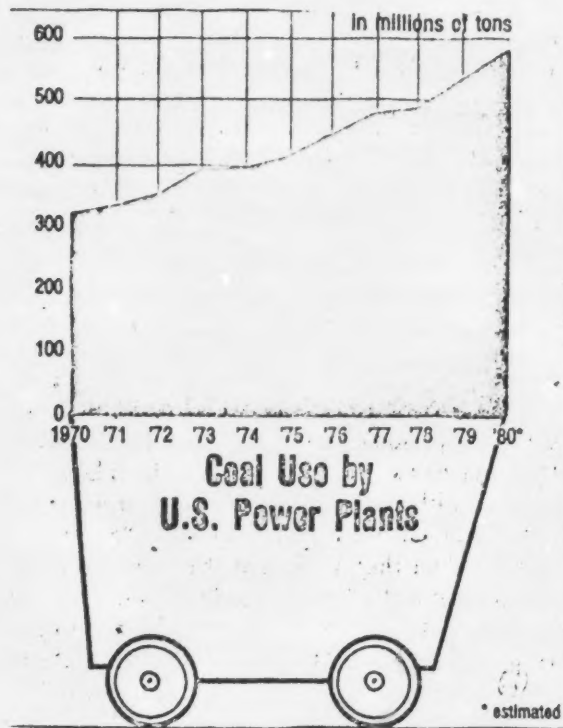
**Residential End Uses of Energy
In Florida**
(Percentages of Total Residential Consumption)

Total Residential Energy Consumption:
1978 523.2 trillion BTU

26.4%	Water Heating
31.2%	Air Conditioning
9.9%	Space Heating
12.4%	Refrigeration
5.2%	Cooking
5.2%	Lighting*
9.7%	Other

*Other includes: clothes drying, television, miscellaneous

1. Studying the chart on the previous page, along with information on energy conservation from publications you can find, speculate how Florida could save on the cost of energy.
2. Pretend that you have the power to enforce 100% of your ideas on consumers. What percent of savings would you think you might be able to accomplish? Why?



"Weekly Reader". Edition 5, Vol. 59, Issue 13, Jan 9, 1981, p. 6.

1. Use of coal by power plants has continually (increased, decreased) through the 1970's.
2. According to this graph, how many millions of tons of coal was used in 1970? _____ 1974? _____ 1979? _____.
3. What prediction can you make concerning the future needs of coal by the United States?
4. Could the increased use of coal by U.S. Power Plants influence or affect the average U.S. citizen? Explain your answer.

-- Sheila Tate

Florida		U.S.	
6.9%	Other		
15.3%	Industrial	36.0%	
16.3%	Commercial		
23.3%	Residential		
	Residential & Commercial	37.5%	
38.1%	Transportation	26.3%	

- What is the largest energy consuming sector in Florida? _____
In the U.S? _____
- Give two reasons why the percentage for Florida is so much greater in the consumption of energy for transportation than it is for the U.S?
 - _____
 - _____
- List as many additional facts as you can infer about Florida by studying Florida's energy use.

• Primarily because there is relatively little heavy industry in Florida, the state's per capita energy consumption is lower than in the country as a whole. Since 1960, however, Floridians have increased their use of energy at a faster rate than the national average.

Primary Energy Consumption Per Capita
Florida and U.S., 1960 - 1978

Florida
U.S.

Per Capita Energy Consumption (million BTU)		Percentage Increase, 1960-1978	Relative Growth Rate, 1960-78
1960	1978		
144.8	250.3	72.9	1.7
242.0	358.5	48.1	1.4

- What is meant by "per capita" energy consumption?
- What ideas can you think of that would account for the increase in per capita energy consumption by Floridians from 1960 to 1978?
- What ideas can you think of that would help to reverse or slow down this trend?

**Percentage of Total Energy Consumption
By Primary Energy Source**
Florida and the U.S., 1978

Florida		U.S.
0.1%	Hydroelectric	3.8%
7.6%	Nuclear	3.8%
7.6%	Coal	17.8%
14.6%	Natural Gas	25.5%
70.1%	Petroleum	49.1%

Total Consumption:

Florida 2,266.5 trillion BTU
U.S. 78,474.9 trillion BTU

1. Looking at the consumption of hydroelectric power, give a geographical reason why Florida uses so much less than the rest of the U.S.
2. Looking at the consumption of petroleum, give reasons why Florida uses so much more of this energy source than the rest of the U.S.
3. Compare the use of natural gas in Florida to the use in the U.S. Why does Florida consume so much less, as a percentage of total energy used?
4. Compare the use of coal in Florida to the use in the U.S. Why does Florida use so much less?

Math Activity Involving Calculation of Mileage and the Possible Savings

Each student needs to bring a Florida map or perhaps the Welcome Center can provide you (the teacher) with a classroom set. Ask the student to prepare a route (the shortest possible) from one city to another. For example, from Sebring to Cocoa Beach. The student needs to then calculate the mileage and given a certain amount of money per gallon of gas - he/she can figure using mileage and MPG the number of gallons of gas needed for the trip. After finding this figure, the student will be able to calculate the cost of the trip. Another day's activity could be that the student could prepare a route (disregarding the shortest route) and then follow the same procedure used in the shorter route activity. A comparison should then follow. Hopefully, the student will conclude that a savings could be made taking the shorter route. What could you (the student) buy with these savings? Are you saving energy by taking the shortest route?

Calculations: To find the mileage - the student need only add.
To find the number of gallons used or needed for the trip -
the student divides mileage by MPG.
To find the cost - the student multiplies number of gallons
and cost of gas per gallon.

Advertisements

Show the pupil six car advertisements (sample below). Ask him/her to explain how all the cars are the same. For mastery, he/she must be able to find at least three similarities. Then ask him/her to find some differences between the cars. For mastery the pupil must be able to find at least three differences and be able to explain how those differences could affect the operation of the cars.

Stock #607A

1975 DODGE CHARGER SE

2 dr. hdtip., auto., p.s., p.b., AM radio, air cond., tinted glass, WSW tires, factory warranty, etc.

WAS \$5495 NOW \$4975

Stock #623A

1975 PLYMOUTH VALIANT

Custom 4 dr. sedan, auto., p.s., p.b., AM radio, WSW tires, vinyl interior w/ center arm rest, factory warranty.

WAS \$4495 NOW \$3925

Stock #621A

1975 PLYMOUTH FURY

Custom Suburban 4 dr. wagon, auto., p.s., p.b., AM radio, air, tinted glass, luggage rack, factory warranty, etc.

WAS \$5595 NOW \$4750

Stock #624A

1975 PLYMOUTH SCAMP

2 dr. hdtip., auto., p.s., p.b., AM radio, air, tinted glass, WSW tires, factory warranty, etc.

WAS \$4395 NOW \$3875

Stock #604A

1975 CHRYSLER NEWPORT

Custom 4 dr. hdtip., auto., p.s., p.b., AM radio, air cond., tinted glass, WSW tires, factory warranty, etc.

WAS \$5995 NOW \$5275

Stock #31A

1974 OLDSMOBILE CUTLASS

Supreme 4 dr. sedan, Auto., p.s., p.b., radio, vinyl roof, rear window defrosters, WSW, low mileage, etc.

WAS \$4295 NOW \$3650

Math Activity Involving Weight of Car with the Use of Gasoline

Have each student find out the year, make, weight, and if possible, the miles per gallon of their family car. Hopefully, the teacher will be able to have some years repeat and makes be the same, so that a comparison may be shown. A unit on finding miles per gallon should be done before this lesson. If the student cannot find information on his/her MPG, the teacher should compute the MPG for his/her family's car. A chart can then be made comparing automobiles of the same year by weight and MPG.

Make	Year	Weight	MPG
Ford LTD	1974		
Ford Pinto			
Toyota Celica	1975		

Perhaps you (the teacher) could ask the student to calculate the number of miles a car of a certain weight could travel on a given amount of gas and then have the student compute the number of miles for a car of smaller weight. These results could then be discussed.

Important information which may be useful:

Subcompact.....2,000 pounds.....30 mpg
Compact.....3,000 pounds.....18-20 mpg
Standard.....4,000 pounds.....8-13 mpg
Heavy.....5,000 pounds.....7-11 mpg

Taken from: Energy & My Environment, written by: Matthew J. Brennan, Ph.D., for the Governor's Energy Office, October 1980

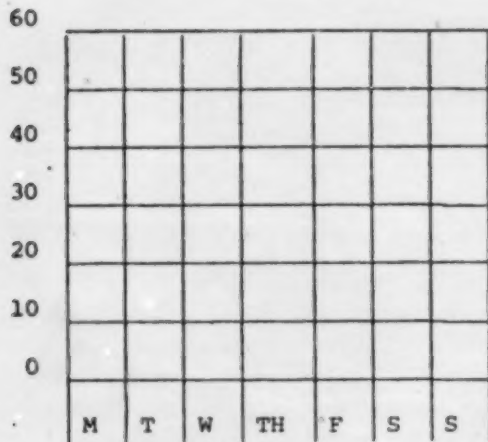
* Remember to try for cars with few options (automatic, air conditioning, power steering, etc.).

Mileage Comparison

For one week keep a mileage check on the use of your family car. During this time, list several ways to cut down on energy waste:

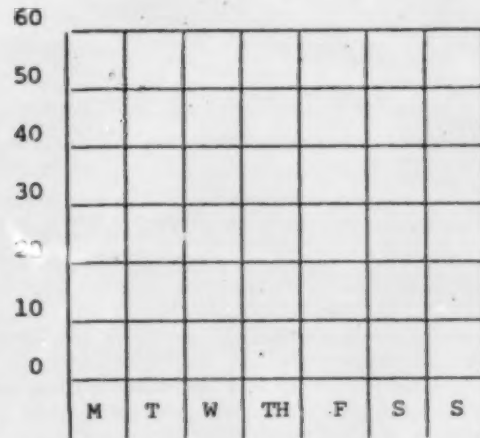
- a) Make a graph showing mileage driven in your family car for each day. During the second week, use the list of mileage saving ideas:
- b) Make a second graph to show difference in two weeks.

First Week



Mileage

Second Week



Mileage

1. How much gasoline was saved?
2. How much money was saved?

America's Energy Sources

List four forms of energy sources, give advantages and disadvantages of each. Then, geographical areas in the United States where that particular source can be found. Locate these areas on a map, use a color code for each source.



Solar Water Heaters: A Little Math!

Heating water with electricity can run one third to one half of a household's monthly utility bill.

Given:

Electric bill for two months (60 days)	\$ 100
Kilowatt hours (kwh) for billing period	2349
50% of electric bill is used to heat water, cost of installing heater	1500

Given the above information, determine:

1. Kilowatt hours used per day.
2. Cost of kwh per day.
3. Cost of one kwh.
4. The estimated savings per year when a solar water heater is used.
5. Approximate number of years required to get a return on the investment of the solar water heater.

The above calculation does not take into consideration:

1. Maintenance costs.
2. Possible higher tax assessment because the solar heating system could be considered property improvement.
3. Interest on loan to purchase the system.
4. 31-day months.

On the other hand:

1. There could be a constant increase in the cost of conventional electricity.
2. Possible tax benefits.

Another question could relate to interest rates.

6. If the money for installation of the solar system was borrowed at an interest rate of 12%, how long would it take to recoup the cost?

Answers (approximate)

$$1. \frac{2349}{60} = 39$$

$$2. \frac{100}{60} = \$1.67$$

$$3. \frac{1.67}{24} = .069$$

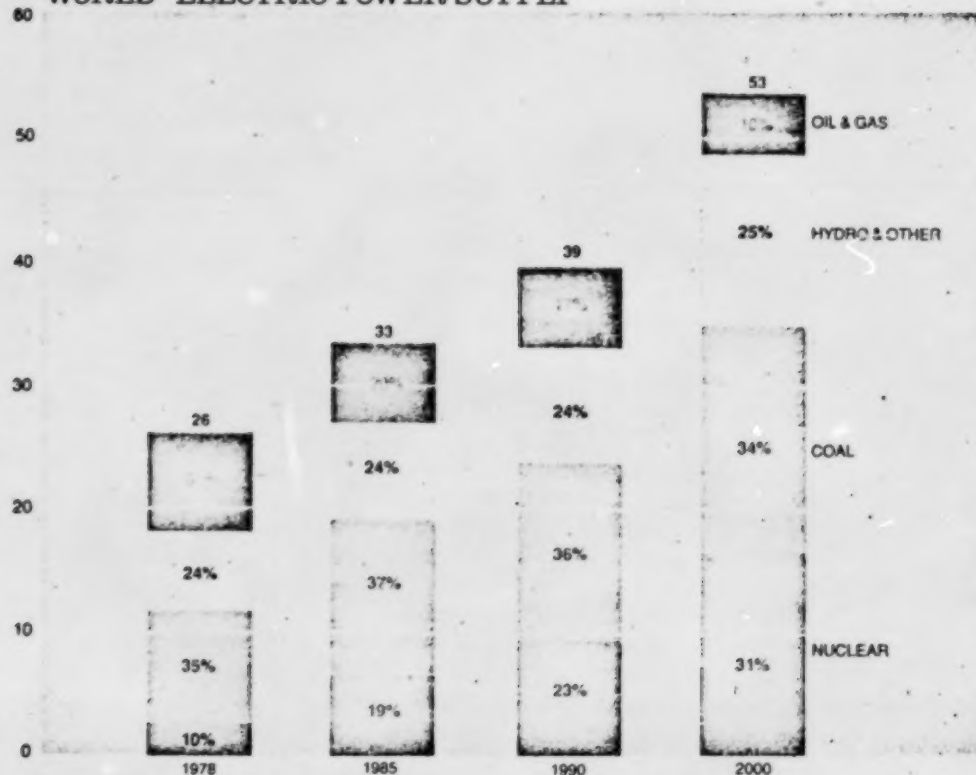
$$4. \frac{39}{2} = 19.5 \\ 19.5 \times 365 \times .07 = 284.70$$

$$5. \frac{1500}{284.70} = 5.2 \text{ years}$$

$$6. 1,500 \times .12 = \$180$$

$$\frac{1680}{284.70} = 5.9 \text{ years}$$

WORLD* ELECTRIC POWER SUPPLY



MILLION BARRELS/DAY OIL EQUIVALENT

*EXCLUDING AFRICA, MIDDLE EAST, U.S.S.R., EASTERN EUROPE AND THE PEOPLE'S REPUBLIC OF CHINA

Electricity is a convenient form of energy. It's consumption is growing at a rate of 3 to 3½ percent a year.

The primary energy sources for electricity are represented in the graph above. Using the above graph, answer the following questions.

1. What could prevent nuclear energy from increasing in usage?
2. Why does hydro power remain fairly constant?
3. The percentage of coal being used will probably decrease as the decades go by. Why?
4. Why was the world largely dependent upon oil and gas in the year 1978?
5. By using the given amount of coal in 1985, how many barrels of oil will be "saved?"

Do we really save money by buying the less expensive item?

The Shirt Saga

We are accustomed to thinking of synthetic fibers and plastics as labor-savers but energy-wasters--materials which require huge industrial plants and valuable petroleum to make substitutes for wood, cotton, wool...substances made from renewable resources. In a lengthy article in the May/June 1978 issue of American Scientist, van Winkle et al, tested that way of thinking by analyzing the energy needs of a lifetime of dress shirts.

Suppose you had two shirts, one made of 100 percent cotton and the other of 65 percent polyester, 35 percent cotton. If you calculate the energy in kilowatt/hours of fossil fuel equivalents at each stage in the shirts' existence, you find that:

	100% Cotton	65% Polyester/ 35% Cotton
to produce the fiber	5.0	9.6
to manufacture the cloth	18.5	20.2
to sew the shirt	2.8	2.8
total manufacturing cost	26.3	32.6
to wash the shirt (automatic washer)	32.2	15.8
to dry the shirt (automatic dryer)	40.8	18.7
to iron the shirt	16.2	5.3
total maintenance cost	89.2	39.8
total cost over a 50- washing lifetime	4486.3	2022.6

So, while it is true that it takes less energy to produce an all-cotton shirt, the 65/35 mixture is more energy-efficient over its lifetime cycle. Of course, if you wash your cotton shirt in cold water, air-dry it, and forget about ironing....



Sciquest, Vol. 53, No. 9, p.20.

Question:

1. How much cheaper is the total manufacturing cost of the 100% cotton shirt?
2. What is the lifetime cost of the 100% cotton shirt? Of the 65%-35% shirt?
3. Over the lifetime of the shirts, which is cheaper?

Map Reading and Thinking

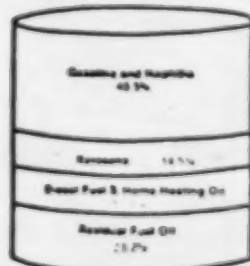
MAJOR U.S. DAMS INCLUDING TENNESSEE VALLEY AUTHORITY



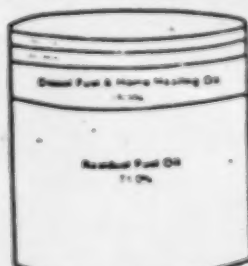
1. List six states that have major dams. What three chief benefits do these dams provide?
2. Pick out three states and, in the library research section, try to determine the amount of energy produced by major dams in each state.
3. Why is there no major dam in Florida and Louisiana?

Thinking It Through:

Is one barrel of oil (petroleum) the same as another? Look at the two barrels below: one from Venezuela, the other from Nigeria. Locate these two countries on a map. Then tell how the two barrels of oil are different. What does this mean for companies which refine crude oil into petroleum products?



Origin Niger River Nigeria



Origin Maracaibo Venezuela

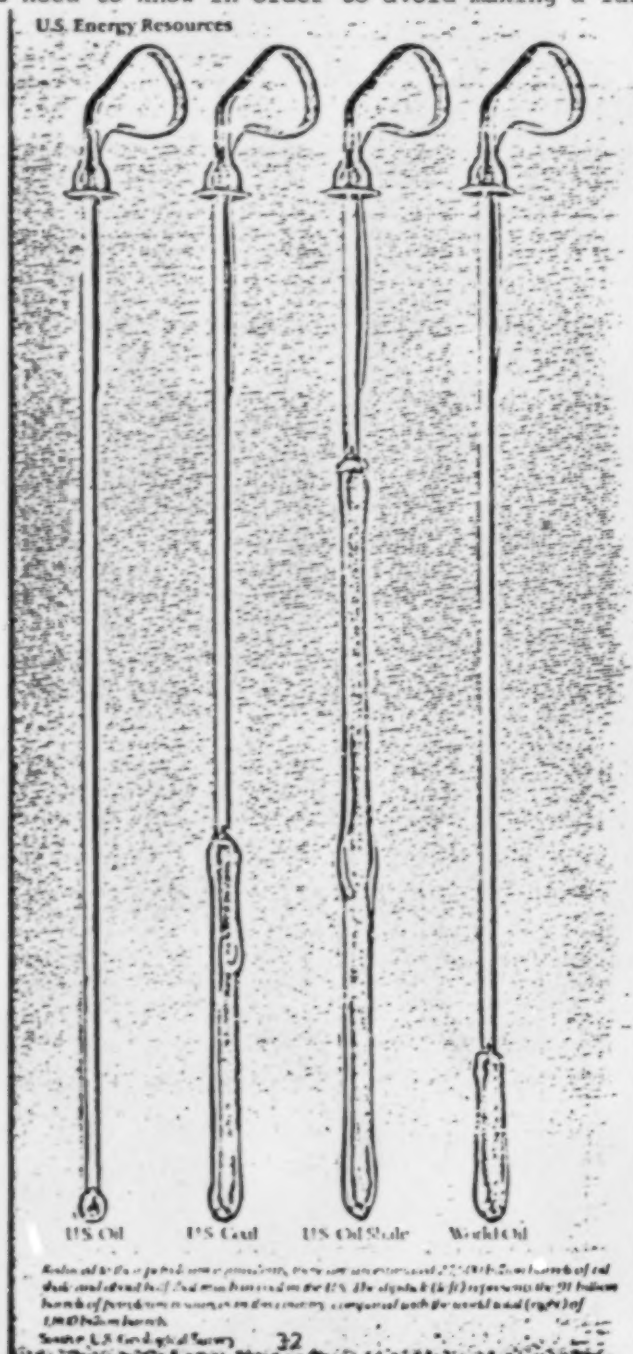
The barrel of Nigerian oil yields 45 percent gasoline and naphtha (a colorless liquid used as a solvent and in the production of gasoline). The barrel from Venezuela yields only 8 percent gasoline and no gasoline.

Oil refineries cannot distill any kind of crude oil--they are built to handle one kind only. Thus, if Venezuela cut off crude oil, a refinery could not switch to Nigerian crude oil!

What Do You Need To Know?

The duPont Company published the picture of the four dipsticks.

1. Why did they use dipsticks? What does a dipstick do?
2. What is the impression that the illustrator hoped to convey? What conclusion did he want you to draw about America's energy and shale oil?
3. What do you need to know in order to avoid making a false conclusion?



*Answer: The concept of net energy. Vast amounts of energy must be spent to free the oil in shale oil.

Energy potential in underground shale oil

- The energy spent to free the oil from shale
- The net energy (the amount of usable energy)

IV. ENERGY PROBLEM SOLVING

Energy Conversions

For the following examples, trace the energy conversions which occur. For example, in "a" there is a conversion from chemical energy (food) to mechanical energy.

- A. A person pedaling a bicycle to run a light on the bicycle.
 - B. Gasoline entering carburetor to exhaust fumes out of tailpipe.
 - C. Burning of oil in a power plant to a light bulb in a house.
1. What is the final form of energy in each example?
 2. The final form of energy in most examples will be heat. Can you predict any problems in the future caused by heat energy?
 3. Which initial form of energy has the highest cost? Which is the cheapest?
 4. Which form of energy do you think is the most valuable?
 5. Develop your own example of an energy conversion?

Hydrogen as a Fuel

Hydrogen is a clean burning, non-polluting, secondary fuel. It is a secondary fuel because it must be produced from chemical compounds found in the environment (e.g., water!). The problem is how to make hydrogen, and then, to store hydrogen for use as a fuel.

PURPOSE: To compare three methods for producing hydrogen: 1) by electrolysis, 2) by the reaction of an acid and a metal, and 3) by an active metal. Each student should be able to suggest methods for solving the problems of hydrogen production and storage.

PROCEDURE: Any chemistry manual will show the laboratory setups for electrolysis, for the reaction of Zinc or Mg (manganese) with an acid, and for the dropping funnel method for preparing hydrogen with FRESH calcium turnings.

Set up the three methods. Demonstrate that hydrogen is indeed produced by each method. Insert a burning wooden splint into the gas produced by each method.

CONCLUSIONS: 1. What problems would you have with each method for producing large quantities of hydrogen?
2. How would you solve each of the problems?

Costs and Benefits

Any decision on energy issues involves both costs and benefits. Get students to bring in newspaper and news magazine clippings which report on proposed solutions to energy problems. Many costs and benefits are hard to measure, but students should try this on some of the clippings. A factory owner may get the benefit of dumping wastes in the air, while nearby homeowners and wildlife pay the costs (breathing dirty air and the accompanying health problems).

For each proposed solution to an energy problem, have students identify:

- A. COSTS: What are the costs of this proposed solution? _____
 Who pays? _____
 How measured? _____
- B. BENEFITS: What are the benefits of this proposed solution? _____
 Who benefits? _____
 How measured? _____

Then, students can decide if the proposed solution is fair (just) and if the proposed solution is acceptable to them.

Twenty Energy Policies

Use the Twenty Energy Policies listed below or have students generate their own list. Have them underline or star (*) the ones with which they agree.

Then, help them raise questions about each of these suggested Policies:

1. What are the likely consequences of this proposed public policy?
 2. Is the proposed public policy feasible? (Is it realistic?)
 3. Who benefits from this proposed policy?
 4. Who loses, or is harmed, by this proposed policy?
 5. Are some people asked to absorb a greater amount of loss or harm than others?
 6. Is the loss or harm balanced by the benefits to all, or the benefits to whom ever will benefit?
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- A) "Restrict speed limits to a maximum of 55 miles per hour."
B) "Limit heat in public buildings to 65° F and cooling to 78° F."
C) "Give income tax credits to all who install solar energy device or who install energy efficient devices (e.g., insulation)."
D) "Add 50 cents per gallon tax to cut down on the use of gasoline."
E) "Ban all students from driving to school if bus service is available."
F) "Ban driving all private cars on Sunday to save gasoline."
G) "Prohibit auto racing to save energy."
H) "Raise the age for a driver's license from 16 to 18 years of age."
I) "Stop aiding poor people by government grants to pay their energy bills."
J) "Convert at least 30% of the U.S. corn crop each year to gasohol."

- K) "Lower pollution standards on cars so they will get better mileage and save gasoline."
- L) "Reduce oil imports by 20%."
- M) "Require schools to stop all athletic programs to save gas and electricity."
- N) "Double the price of electricity to reduce consumption."
- O) "Prohibit the manufacture and sale of all private vehicles which do not get 40 miles per gallon."
- P) "Outlaw the manufacture and use of electric space heaters."
- Q) "Provide tax credit, up to 40%, for the installation of solar hot water heaters."

Role-Playing Energy Issues

Role-playing is an effective tool for students to act out various values feelings, and social roles--learning all the while. Teachers should use the following process:

1. Preparing the Group*

- Set the stage by relating the purpose of the activity in the instructional unit and check student comprehension of the facts involved in the case.
- Select players.
- Inform the "audience" (non-players) what they should be doing and listening for.

2. Enactment(s)

- Students act out their interpretation and conclusions for the case including the emotions they feel are appropriate and the strategy for handling the conflict.
- Enactment may be repeated a number of times to obtain a variety of conclusions, strategies, and feelings.

3. Follow-up

- Use discussion, the key part of the activity, to deal with the interpretations employed, to get participants to explain and justify their interpretations and strategies.
- Use discussion to evaluate the role-playing performance with the emotions, strategies, conclusions, etc., reached by the players.
- Evaluate the entire activity: what did you learn? Was the activity worthwhile? Why? Why not?

The following case is an example of how role-playing can be used with energy issues:

This year the State cabinet with its consultants established air quality standards for the entire State. The standards were reasonable, according to the

* See Fannie R. Shaftel and George Shaftel, Role Playing for Social Values: Decision Making in the Social Studies (Englewood Cliffs, N.J.: Prentice Hall, Inc., 1967), pp. 74-80.

consultants, given our knowledge about the health needs of people and the future trends in air quality. However, the power companies complained. They demanded that the standards be relaxed. They claimed to be caught in a bind: between controls by the government on their profits and the amount they could charge for electric power, on the one hand, and the high costs of meeting the new air quality standards, on the other. "We can't pay for this out of our meagre profits," they asserted. "If we do, no person will invest in power company stock and we will not have the funds to invest in facilities to meet the ever increasing demand for more electricity." The citizens, using the electric power, obviously don't want to pay more for electric power.

In several areas of the state where many senior citizens reside, these older citizens complain that the standards are based upon healthy middle aged persons' requirements. For the elderly, or for persons with respiratory difficulties, the air quality standards are far too low. These persons could have great difficulty breathing even if the existing standards are met.

In rural areas, there are many employable poor persons seeking jobs which can only be obtained by additional economic growth.

Roles for Role-Playing

- The president of a State utility company
- The leader of a senior citizen's group
- An advocate of jobs for poor Floridians
- A leader of the Florida Lung Association
- A consumer advocate favoring low-cost electricity
- A business leader, wanting to have low-cost electricity to attract more business to Florida.

Mock Trials on Energy

A mock trial is a useful lesson technique for the study of controversial issues. The following sample lesson can be modified for the study of other energy issues.

PROCEDURE: Select one issue for the trial. The issue should be stated in terms of "should" or "ought." For example, "The Federal Government and all State governments should maintain the maximum highway speed limit of 55 miles per hour."

TRIAL

PREPARATION: Divide the students into pro and con teams. One student should serve as Clerk of the Court and three students should serve as questioning judges. At least five students should serve on the jury, and will make a decision on the winning side.

Students should do research and prepare their arguments. The pro team would list the factors supporting the 55 MPH law. The con team would list the factors against the law.

THE TRIAL: The students' goal is to convince (using reasonable, accurate, and logical persuasion) a skeptical student jury of the soundness and merit of their position on the law.

After the pros and the cons have been presented, the judges question each side. Each side is allowed three minutes for a closing summary of their position.

Then, the jury votes on the winning argument.

FOLLOW-UP: Students could write up their arguments and send them to Governor D. Robert Graham and the Governor's Energy Office, 301 Bryant Building, Tallahassee, FL 32301. These papers will be opinion papers, conveying the student's judgments and supporting arguments.

Congressional Hearing on Energy

Few Americans understand the government hearing process which is designed to gather, question, challenge, and summarize information. These hearings form the basis from which Congressmen determine their views for drafting legislation. While a research lesson on energy problems, this activity provides the opportunity to participate in a government operation. Students will learn to survey, research, summarize, and apply information. A careful study will allow students to evaluate the nature of this government procedure and the implications of the resulting law.

Objectives

After participating in the energy hearing simulation, students will be able to:

1. Better understand the range of opinion on energy issues.
2. Present a position, utilizing the skills of summary and analysis in a role-playing situation.
3. Apply acquired information to construct an energy bill.
4. Evaluate community activities which affect energy problems, and consider alternative measures.
5. Review a Federal law as it emerges from Congressional hearings and evaluate its implications.
6. Better understand that the creation of government policy is ultimately dependent upon citizen concern, communication, ideas, and public awareness.

Procedure

The basic teaching strategy is a simulated Congressional hearing and the accompanying role-playing activities. After an initial inquiry into energy conditions, the class forms special interest groups to draft an energy bill. The proposals of the class's bill are then presented in the hearing format where students assume the roles of examiners, witnesses, and so on. When all the testimony has been heard, a student committee considers the class's proposals, making appropriate changes and modifications to construct a viable energy bill, on which the students then vote.

Step One:

Have students list basic energy problems and present views on what has been done to solve these problems and what still needs doing. At this point a film would be useful to review the scope of the energy problem.

Useful sample issues include: our environmental quality has worsened in the last three years; the energy crisis has been exaggerated; and the energy concern is a short-lived fad.

Step Two:

Organize the students into special interest groups to research energy issues. Suggested topics include: fostering solar water and space heating; energy conservation in transportation; curbing oil imports; and Energy and the Environment.

Step Three:

On the basis of their research, each group writes a proposal for the draft of the class's energy bill. Students should refer to the provisions of the 55 miles per hour speed law (National Science Teachers Association, How A Bill Becomes A Law To Conserve Energy).

Step Four:

Assuming roles similar to those found in the actual hearings, students prepare to testify on their bill proposals by studying appropriate positions, finding supportive outside materials, and engaging in group discussions.

For example, the hearing on the topic of air pollution would include at least two witnesses: one to testify that present standards and practices are inadequate, and one to refute this testimony. An alternative approach to the same issue is to have students role play various persons such as an educator, a conservationist, an architect, a theologian, or an engineer, and give testimony. In both situations, students consult N.S.T.A. unit for source material.

Step Five:

Students conduct hearings. Witnesses are called to testify, presenting their views to a panel of examiners. When all the testimony has been heard, one day is set aside to review the issues so that positions are clearly understood and conflicting ideas highlighted.

Step Six:

A student committee studies the class's proposed legislation in light of the hearings. Using the speed limit law as a model, the committee constructs an Energy Act of 19 __. At this time the rest of the students work on a program to increase community awareness of energy problems.

Step Seven:

The student committee presents the final bill to the class for approval.

Step Eight:

The hearing process is reviewed in the context of the class's action. Copies of the final bill could be sent to your Congressman and selected Congressional committee members.

Evaluation

The effectiveness of the hearing activities can be evaluated by a "before and after" examination of your students which surveys their understanding of:

1. The nature and seriousness of our energy problems.
2. Possible solutions to these problems.
3. The role of the Congressional hearing as a public forum to gather information.

Follow-Up Activities

Community surveys, school meetings on local energy conditions, outdoor projects, and long-term projects to monitor conditions are all appropriate follow-up activities. The students might also hold a citizens meeting to present their findings and suggestions for improvement. *

V. HANDS-ON ENERGY ACTIVITIES

Water Heating By Solar Thermosiphon

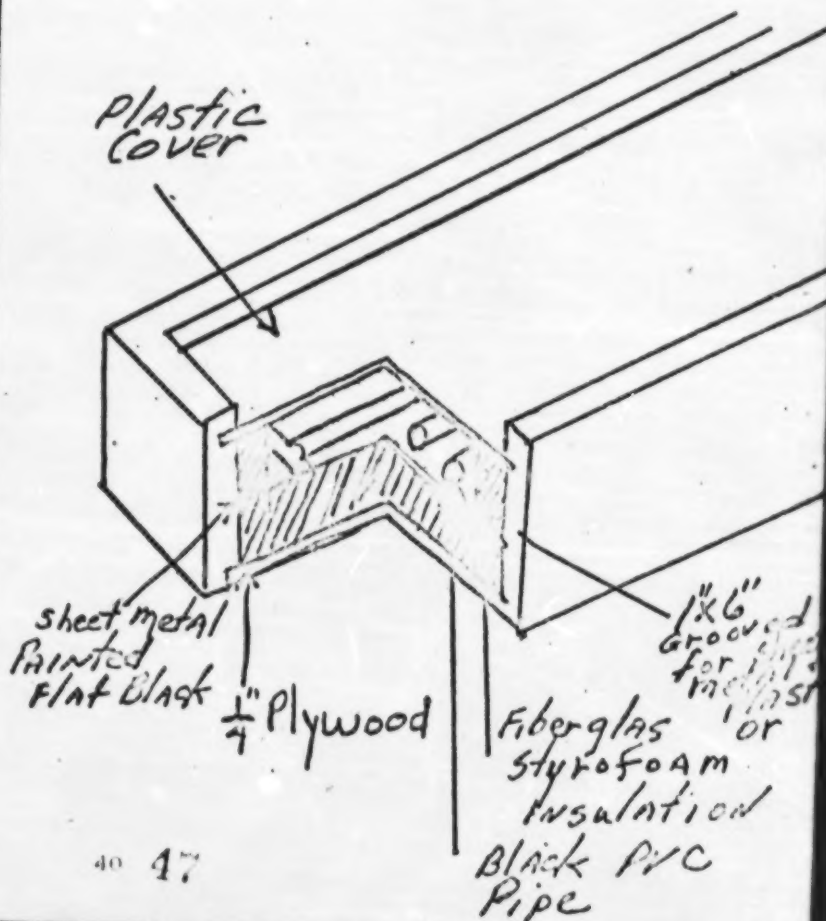
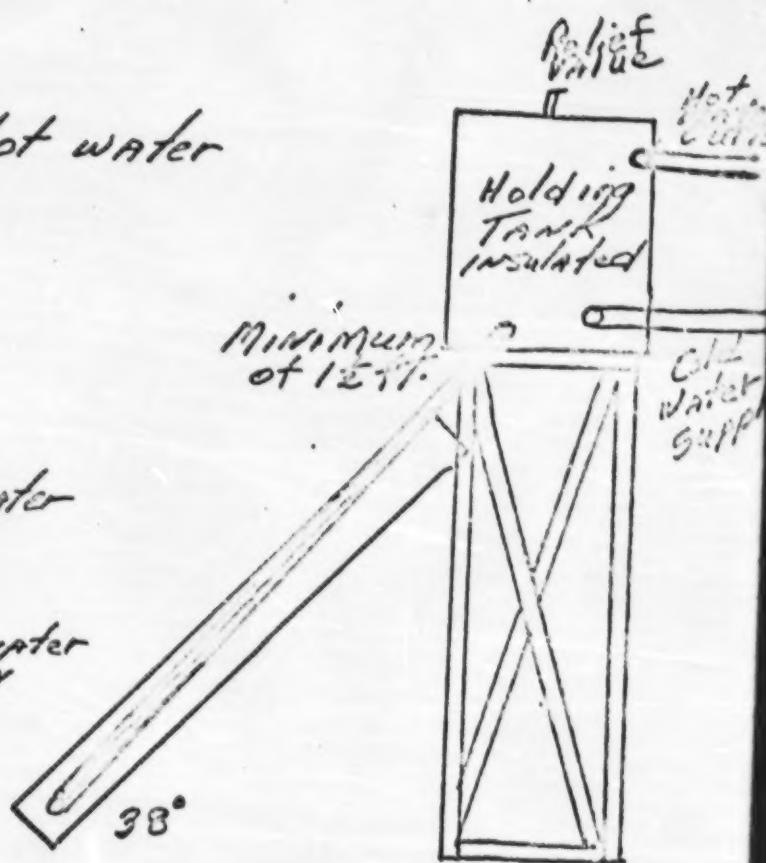
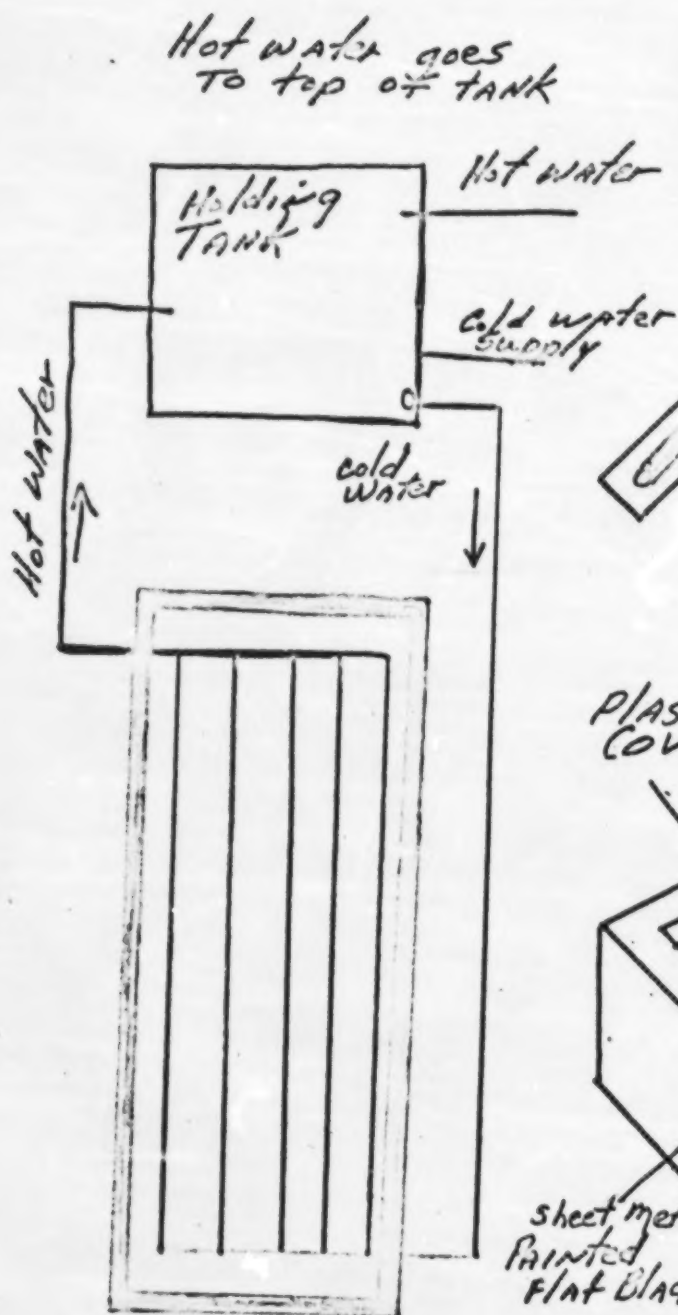
OBJECTIVE: Construction of a solar powered water heater.

LIST OF

- MATERIALS:
- 1 - 12 linear feet of 1 x 6" wood (cheap)
 - 2 - 32" x 48" of fiberglass or foam insulation
 - 3 - Two 2 x 4' metal or wood, 1 painted flat black
 - 4 - One 2 x 4' piece of 1/8" plastic (translucent preferably)
 - 5 - Black PVC pipe & connectors
 - A. 6 - 90° elbows
 - B. 8 - 3 way T's
 - C. 30 linear feet 1" pipe
 - D. Three connectors (PVC) to enter & exit holding tank
 - 6 - Holding tank - old (small) hot water heater or insulated 5 gallon bucket
 - 7 - 5 feet high stand for holding tank constructed with 32 linear feet of 2 x 2" wood
 - 8 - Some nails or wood screws (cheapest)

* Reference: Adapted from material first produced by the Social Science Education Consortium, Boulder, Colorado, for environmental education. This material is not copyrighted.

Thermosiphon Hot water system



Plan of Procedure

1. Procure materials.
2. Cut 1 x 6" wood - two 4' length & two 2' length.
3. Rabbet all four pieces on bottom edge to receive the bottom piece (wood - 1/4" plywood sufficient).
4. Cut dado to receive flat black materials (wood or metal, but metal is best) from bottom rabbet to permit 2" for insulation.
5. Dado at top of frame may be varied to receive translucent plastic collector (late).
6. Drill 1" diameter holes at bottom & top of frame sides (on opposite sides) to receive & reject the storage pipes.
7. Affix bottom to two sides and one end.
8. Install insulation materials.
9. Insert metal, flat black painted, absorber plate.
10. Cut five 3' lengths of pipe.
11. Affix 90° elbow to one end of two of these lengths.
12. Affix three-way T's to the other end of those with 90° elbows & the remaining three lengths cut to 3'.
13. Lay the five 3' lengths of pipe in the box, on the tin plate. Adjust them to leave 4" space on the two sides & equal spaces between others.
14. Cut & secure these pieces (glue, etc., - if inside connector T's used also use hose clamps) at all T junctions.
15. Cut two 1' lengths of black pipe & insert through 1" diameter holes in sides of collector box & secure in 90° elbows at each end.
16. Insert plastic collector plate in top dado & secure other end piece.
17. Construct stand for holding tank - five feet high from 2 x 2" stock (or plywood, or whatever is available) to size necessary to solidly support holding tank.
18. Secure 90° elbows to pipes protruding from collector box.
19. Mount holding tank securely to top of stand.
20. Position collector box leaning against holding tank stand with best exposure to maximum sunlight. Southern exposure best at approximate 35° angle. (Minimum of 18" between bottom of tank and top of collector.)
21. From bottom of collector (90° elbow) cut straight length of pipe of sufficient length to enter close to the bottom of the holding tank.
22. Secure to collector box, affix 90° elbow at top.
23. Cut length to enter tank from 90° elbow & connect to tank.
24. Utilize connector to provide water supply (from a hose or faucet, etc.) near the bottom also.
25. Enter top of tank with connectors & mechanism to contain & release hot water.

Discussion:

1. Should provision be made to drain the storage pipes from bottom of collector? Why? Why not?
2. Should provisions be made to provide a pressure release valve at top of tank? Why? Why not?

Wind Generated Electrical Power

OBJECTIVE: Offer an alternative source of electricity through construction of a windmill.

MATERIALS

LIST:

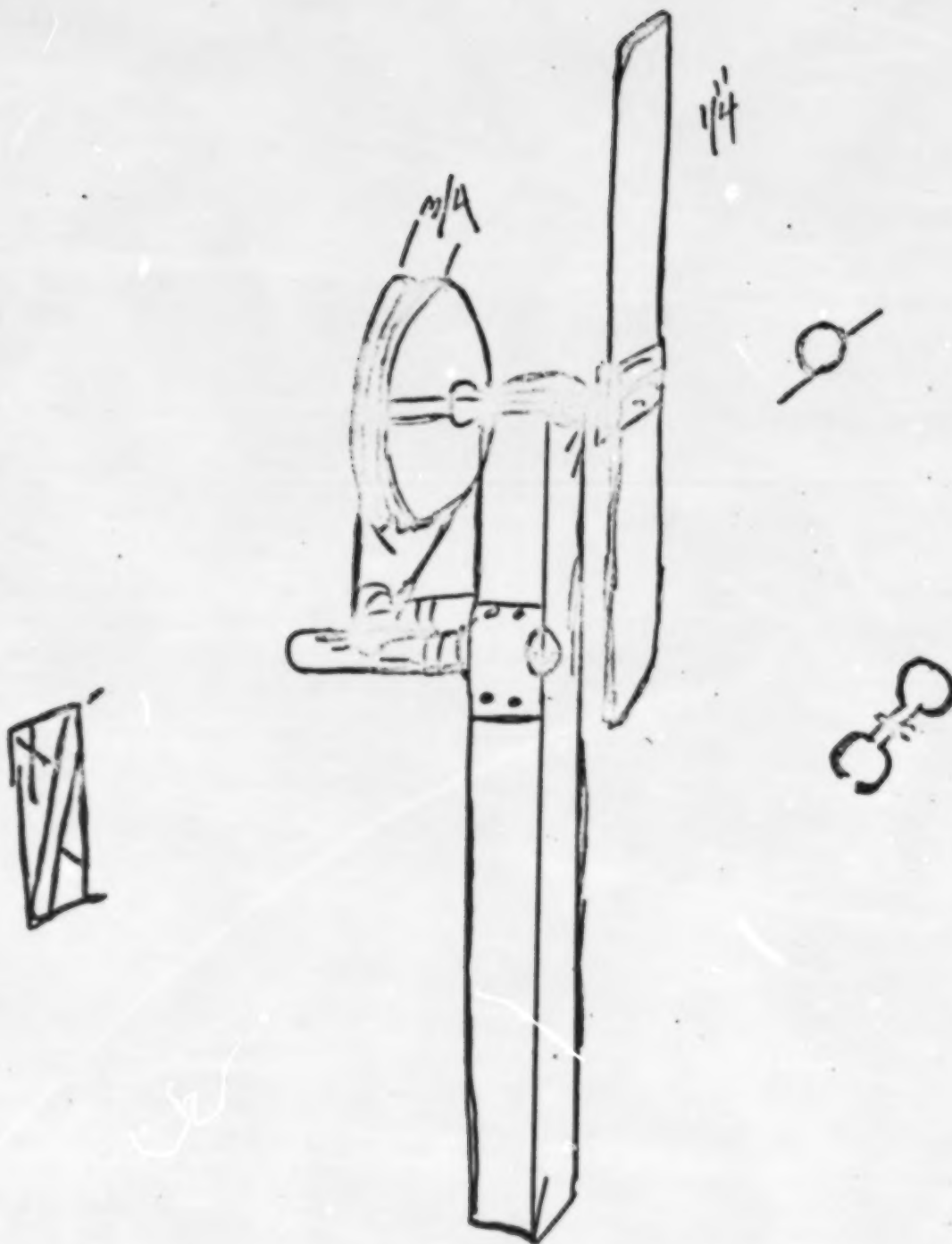
1. 2 x 2" x 8' (one) upright.
2. 1 x 4" x 4' (one) propellor
3. One bicycle (front) wheel with axle and nuts.
4. One DC (6 or 12V) generator (i.e., bike light).
5. 12" diameter pulley, 3/4" thick (wood)
6. 1" pulley (wood) drilled to fit generator shaft.
7. 3/4" conduit 12" in length.
8. Two 3/4" pipe clamps.
9. Two 1/2" pipe clamps.
10. Old tire inner tube (bicycle) for belt on pulleys.
11. One constructed clamp, to size, with adjustment variants for generator.

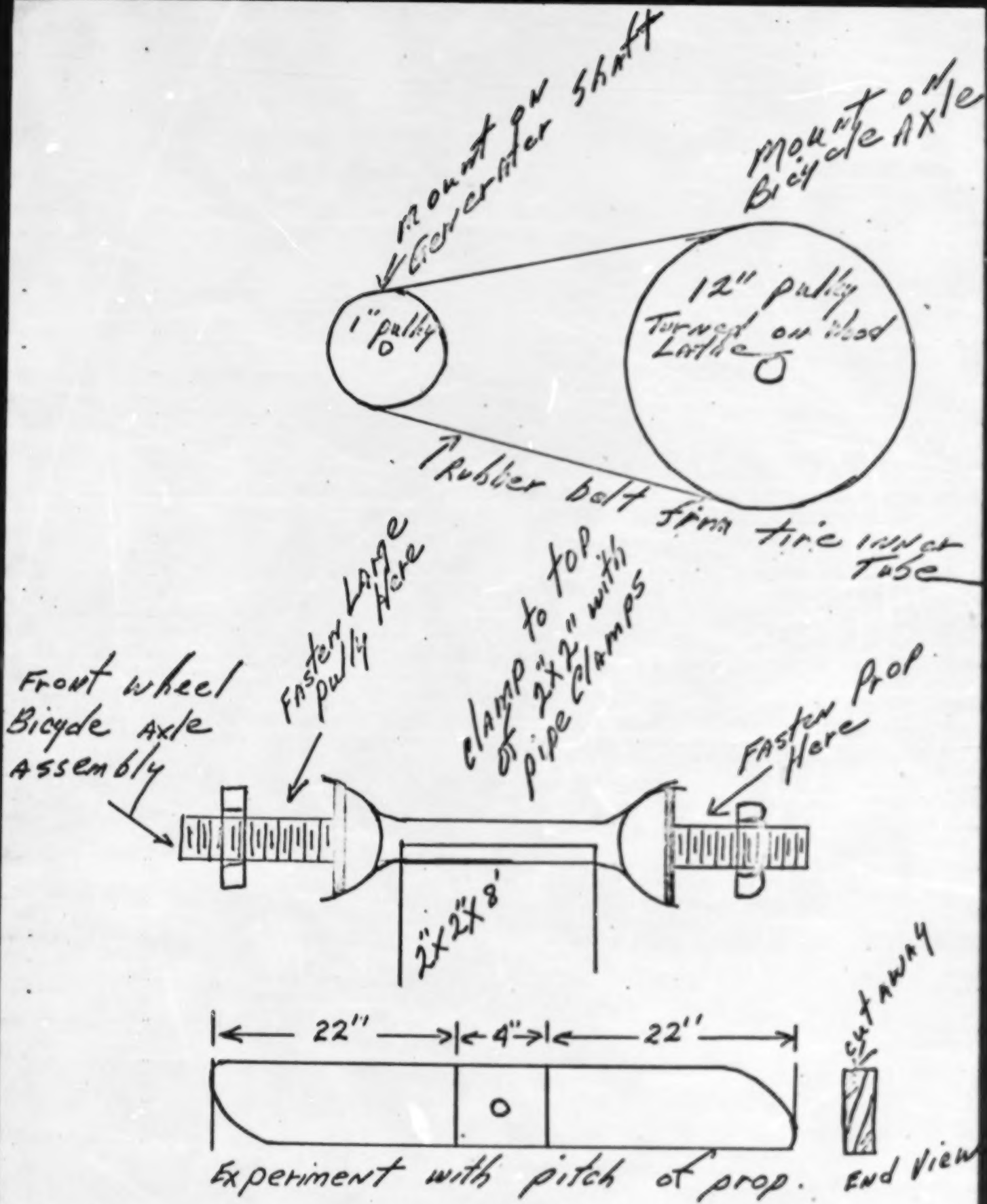
PLAN OF

PROCEDURE:

1. Set ban saw tabs at 20° - cut both sides of 1 x 4" x 4' board to within 2" of center on both ends.
2. Remove spokes from bicycle wheel.
3. Mount bicycle wheel hub to top of 2 x 2, with 1/2" pipe clamps.
4. Turn pulley on wood lathe (12" offered as example. Larger pulley more generating power).
5. Turn small pulley - 1" preferably but at least as small as may be safely turned.
6. Cut groove in side of 2 x 2 to fit belt length & clamp 12" piece of 3/4" conduit to upright.
7. Mount generator on conduit with pulleys in line with constructed (or purchased) clamps.
8. Appropriate test device, simple 6 or 12V light (flashlight bulb, etc.) wired to generator.

SEE NEXT TWO PAGES FOR EXAMPLES!





DISCUSSION TOPICS:

1. Is local wind speed constancy adequate to provide a good power source?
2. How much wind is necessary to illuminate/activate the test devices?
3. Can you improve electric generation through variation in propellor configuration?

ACTIVITIES:

1. Vary test devices.
2. Replace propellor with another with a different weight or pitch.
3. Generate at ground level and higher off the ground.

Determination of Electrical Energy Consumed by Portable Household Appliances and Shop Tools in Kilowatt Hours

OBJECTIVE: Construction and use of a watt meter unit supplied by household current.

LIST OF

MATERIALS:

1. 1 piece 3/4" plywood 10 x 18"
2. 1 piece 3/4" plywood 10 x 12"
3. 1 piece 4" square wood (any kind)
4. Wood screws - 4 #10 3/4" (2 for base plate of meter & 2 for receptacle box)
6 #10 1" (2 for base to upright unit & 4 for upright back supports)
5. Length of #12 electrical wire (wires) sufficient to reach wall receptacle from intended location of the unit plus about 12" to wire meter to the unit receptacle.
6. 1 electrical plug (3 prong)
7. 1 electrical receptacle box (3 prong) with ground capability.
8. One watt hour meter, with mounting plate, available from local utility company (with any kind of luck).

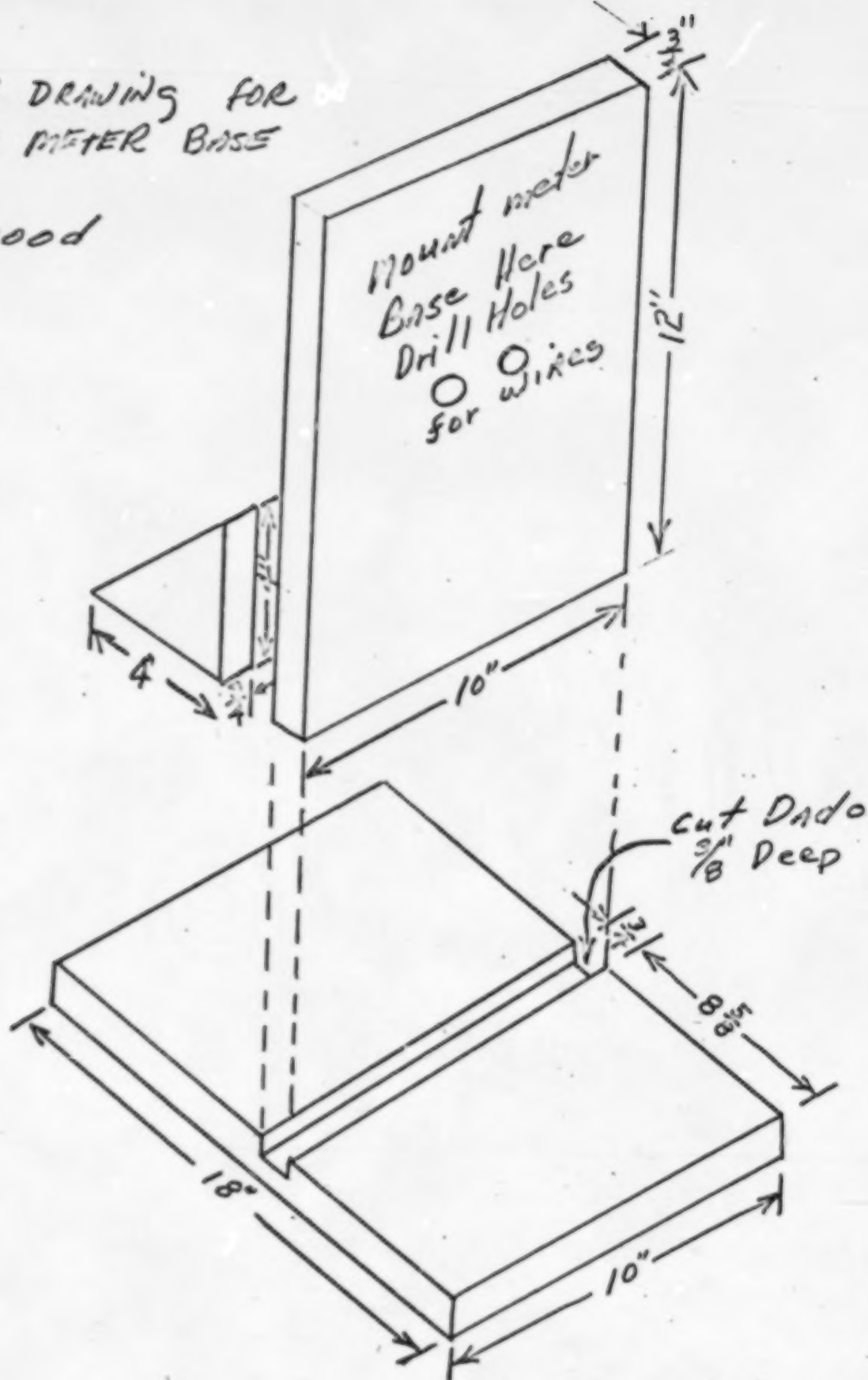
PLAN OF

PROCEDURE:

1. Procure materials.
2. Cut a 3/8" deep & 3/4" wide dado groove at center of 18" long piece of plywood.
3. Glue upright into dado groove & use 2 #10 (1") screws through base into upright.
4. Cut 4" square wood diagonally from corner to corner (45°) for upright supports.
5. Glue & screw angled supports to upright & base unit at each side (4 #10-1" screws).
6. Affix watt meter base plate to face of upright (opposite of supports) with 2 #10 3/4" wood screws.
7. Install watt meter to base plate. Drill appropriate holes in upright for wire passage.
8. Affix receptacle box to base unit (to the rear of the upright supports) with 2 #10 3/4" wood screws.
9. Cut 12" length from electrical wire & connect receptacle to watt meter (#12-3 wire).

ASSEMBLY DRAWING FOR
WATT HOUR METER BASE

$\frac{3}{4}$ " Plywood



10. Connect 3 prong plug to remainder of electrical wire (#12-3 wire) (either end).
11. Connect (the other end) electrical wire (#12-3 wire) to the watt meter.

DISCUSSION

- TOPICS:
1. Which appliances and tools are most used in the home or shop?
 2. Which devices will consume more/less energy?

- ACTIVITIES:
1. Solicit appliances from students, from home, or work in harmony with your Home Economics teachers and use their appliances.
 2. Teach students to read the watt meter.
 3. Teach students the cost of electricity per kilowatt hour.
 4. Using appliances and shop portable electrical tools, test all devices for energy consumed per hour of use. Prepare charts to record KWH utilized and calculate cost of each.

Alcohol Production Demonstration

--Davis Gandeas
Lake Placid Middle School

Before doing this demonstration legally, a permit should be obtained by writing to the U.S. Alcohol, Tobacco and Firearms Bureau.

This is a very inefficient demonstration using more energy than you produce. Industrial or solar stills are much more efficient as are stills that use waste heat and renewable sources.

MATERIALS

- NEEDED:
- 12 ripe oranges
 - 1 plastic 1 gallon milk jug
 - 1 stopper #9 hole to fit jug
 - 2' rubber tubing to fit in stopper
 - 1 jar or glass
 - 1 package of activated yeast

- PROCEDURE:
1. Cut up 12 ripe oranges into small pieces.
 2. Put the orange and any juice into the jug.
 3. Pour about 1/2 gallon of hot water into the jug.
 4. Empty the contents of yeast into the jug.
 5. Shake thoroughly.
 6. Put stopper in jug and put one end of the tubing into the stopper and the other in the bottom of a jar of water. (This is an air lock.)
 7. Let contents sit for 2 to 3 days or until all bubbling stops.
 8. You now have a mixture of pulp, water and alcohol. During the fermentation process, bacteria digested the sugar in the oranges into alcohol.
 9. Pour off all the liquid and allow the pulp to dry in the sun. The pulp is now DDGS--Distillers' Dried Grains and Solubles--and is an excellent cattle feed very high in protein.

10. Pour the liquid into the still and heat no higher than 180° F. (The boiling point of alcohol is 178°.) Be sure to keep the condensing tube cool with ice.
11. Be sure to clean out the still when finished as it will rust out if not clean and dry.

BUILDING

THE STILL: If you are not proficient at soldering, your industrial arts teacher would probably be glad to help you. A lab distilling apparatus may be used or various plans for solar and woodburning stills are available from "Mother Earth News."

MATERIALS:

- 1 1 gallon can (the type used for ditto fluid)-rinse thoroughly.
- 1 1 gallon can (the type vegetables come in--available in school cafeterias).
- 5 ft. 1/4" soft copper tubing (hardware store or plumber)
- 1 small jar (to collect alcohol).
- 1 #9 stopper with 1 hole
- 1 lab thermometer
- 50/50 solder
- solder flux
- propane torch
- scrap fiberglass insulation

BUILDING

PROCEDURE:

1. Use the empty ditto fluid can for your burner. Be sure to rinse it out as ditto fluid is flammable.
2. Use the other 1 gallon can for your condenser.
3. Connect the top of the burner with the inside bottom of the condenser. The copper tubing should be coiled inside the condenser.
4. Wrap the upper section of the burner with insulation and be sure to insulate the tubing down to the coil to prevent premature condensation.
5. Use an alcohol burner, bunsen burner or hot plate for a heat source.

EXPERIMENT:

1. Try painting one side of the burner black and letting the sun distill the mash.
2. Try hooking the still up to a small solar collector to demonstrate how solar energy or other types of renewable sources could be used.

Solar Hot Dog Cooker

--Davis Gandeas
Lake Placid Middle School

MATERIALS

NEEDED:

- 1 Parabola pattern (call Davis Gandeas)
- 1 Piece aluminized 39" x 28" mylar (available from Edmunds' Scientific)

Heavy cardboard or 1/4" plywood

- 1 39" piece of 1" x 1" aluminum angle or 1" i.d. aluminum tube
- Various pieces of 1" x 2" scrap wood

- PROCEDURE:
1. Use the parabola pattern and trace 3 curves on cardboard or plywood and cut out.
 2. Use scrap wood and assemble curves and frame.
 3. Cover curves with smooth heavy cardboard or thin sheet of metal, etc.
 4. Cover curve with mylar. Glue it if desired. Spray contact would be ideal.
 5. Position angle or tube at focal point 10" from base of curve.
 6. Use 1" x 2" wood to make legs that are adjustable to aim collector at sun.

Concentrating collectors work best on clear days. Even a slight haze greatly reduces their effectiveness.

Windmill Demonstration

--Davis Gandeas
Lake Placid Middle School

MATERIALS

- | | | | |
|----------------|-------------------------------|------------------------|----------|
| <u>NEEDED:</u> | 1 permanent magnet motor | 2 1/2" galvanized caps | Plumbing |
| | 1 balsa wood 12" x 2" x 3/16" | 2 3" x 1/2" nipples | Supply |
| | 1 yard stick | 1 1/2" galvanized tee | Store |
| | 1 coat hanger | 6' 1/2" EMT conduit | |
| | 1 cat food can | 1 0 to 6 volt meter | |
| | 2 2" hose clamps | 4' 2 strand wire | |
| | 1 steel piece 1" x 1/2" x 3" | 2 3" rubber bands | |
| | 1 5/16" bolt and nut | | |
1. Shape yardstick halves to an airfoil shape.
 2. Twist the piece of steel approximately 30°.
 3. Bend coat hanger to shape to hold tail parallel with shaft.
 4. Use remaining coat hanger wire to hold motor in line with can.
 5. Use a 3" rubber band for a V-belt.

- PROCEDURE: Set up windmill in a high area that is clear for 200 to 300 feet in all directions. Note how voltage increases with wind speed. Use an anemometer and graph windspeed against voltage output. Move windmill to various places with obstructions, low spots, etc., and note the performance change. Experiment with larger blades and note the performance change with the same wind speed. Experiment with different size pulley arrangements and note the performance changes.

Windpower is dependent on many variables which should be clearly understood by anyone planning to harness the wind, especially for electric generation.

FREE ENERGY FILMS

I. Gulf Oil Company, M.A. Halaney, PO Box 1563, Houston, Texas 77001

THE MAGIC OF REFINING

(15 Mins. Color)

Animation and still photos of elements of refineries illustrate the three stages of oil processing--distillation, catalytic processing and blending. Film also briefly covers how oil is formed, found, produced and transported for processing and the range of products made from it. Environmental controls applied at refineries in the interest of clean air and water also is treated briefly. Animation gives impression of what takes place inside the pipes and vessels of a refinery as it changes the shapes and sizes of hydrocarbon molecules to convert them into a myriad of products.

SUPERPORT

(12 Mins. Color)

A lilted, lyrical voyage to historical Bantry, Ireland, where the Spanish Armada once made port and which now plays host to one of the major crude oil terminals of the world. This emerald isle, this touchstone of beauty, whose earth has nourished some of our greatest poets and dramatists, has joined the struggle for energy by sharing some of its precious land heritage with Gulf Oil Corporation. Gulf, in turn, has blended the terminal with surroundings landscaped to retain the beauty of its port. The Clancy Brothers celebrate the occasion with some lively songs and chants.

UNSEEN JOURNEY

(29 Mins. Color - Revised Version)

Oil travels many unseen journeys before it reaches the refinery . . . each a tribute to man's scientific skill, ingenuity and determination. This creative film dramatically shows how oil is brought to the surface on land and offshore and transported hundreds of miles by "big inch" pipelines, barges, and tankers to feed distant refineries to meet the needs of our moving lives. Gives a rich insight into that part of Americana concerned with transporting oil.

MIRRORS OF TIME

(28 Mins. Color)

At the leading edge of man's quest for natural resources living beneath the oceans, the research vessel Hollis Hedberg carries teams of earth scientists to new frontiers. On board, sophisticated sensing and detection devices render secrets of the earth's structure beneath the ocean floors. Analyzing the data from this sweeping search of the continental shelves, scientists find clues to improve the odds of finding oil and gas deposits offshore. Aboard the ship and ashore, the excitement of their roles in this fascinating adventure is reflected in MIRRORS OF TIME.

THE ENERGY BRIDGE

(21 Mins. Color)

An informative documentary film about surface mining of coal. About three trillion tons of coal are estimated to be in the U.S. About half is recoverable. This film illustrates how surface mining goes hand in hand with land reclamation. The company shown has pioneered in the development of reclamation equipment.

PERSPECTIVE

(15 Mins. Color)

"Perspective," a challenge to thinking people to examine their views on four current issues . . . marriage, gun control, air pollution, surface coal-mining. Marriage, the bedrock that establishes the family as society's most durable and vital unit. Is its very existence threatened or is "open marriage" a passing phase? What was the real purpose of the Constitution's avowal of the individual's right to bear arms? In an urbanized industrial society, does it any longer make sense? Are there absolutes to guide us through the many conflicts between environmental protection and economic need? Or will it come down to the tested democratic principle of trying each case on its merits? How do we develop perspective on an issue dramatized as the "rape of the earth"? Can deeply held emotional convictions be penetrated to create a reasonable perspective on surface mining of coal? See your views reflected in the pro-and-con explorations of these major current issues. Hear them, as you and your associates reflect on the meaning of Perspective: the ability to see things in a true relationship.

II. Exxon Film Library, Modern Talking Picture Service, Inc., 2323 New Hyde Park Road, New Hyde Park, N.Y. 11040

Three E's #04900.
(Energy Economics and the Environment)
28 minutes, 16mm color, sound, high school to adult, available with teacher's guide

This film describes the complex relationship between energy, economics and the environment. It shows how the three E's are interdependent, relates the problems that have arisen in each area and offers some solutions by experts in a number of areas. This film confronts the viewer with a basic question: How much is each of us willing to sacrifice in order to solve the problem?

World Beneath the Sea, #04904.
28 minutes, 16mm color, sound, high school through adult

Man's relentless search for oil and gas off the coasts of the United States is described in this film. *World Beneath the Sea* tells how offshore drilling developed through the years and shows the various types of platforms used today. The film explains and shows the devices used by the industry for safety and environmental protection. It also deals with the onshore side of offshore development.

Faces of Energy. #04906.
28 minutes, 16mm color, sound, high school through adult

This magnificent documentary tells the story of the petroleum industry through a series of individual portraits of people at work in its various functions. The story was filmed in the Atlantic with an exploration ship, along the Alaskan pipeline, offshore in the Gulf of Mexico on an oil platform, aboard a tanker moving along the lower Mississippi River, in a California refinery, and at a lobster-loading dock in Beals Island, Maine.

Refinery, #4879.
16 minutes, 16mm color, sound, high school to adult, available with teacher's guide

The amazing process of converting crude oil into everyday consumer products, such as gasoline and home heating oil, is shown in this film. Though the steps are complex, this film explains clearly and simply through animation and live action footage how the crude oil is turned into numerous useful products to serve mankind.

Nuclear Energy: Power for Today and Tomorrow, #4884.
28 minutes, 16mm color, sound, high school to adult, available with teacher's guide

Nuclear energy will play an increasingly important role in the years ahead in helping America meet its expanding energy needs. This film describes Exxon's part in the search for, mining, milling and fabrication of nuclear fuel for power generation.

III. Typical Private Industry Energy Film Sources

Allis Chalmers Manufacturing Company Tractor Group Milwaukee, WI 53201 414-475-2000	Edison Electric Institute 90 Park Avenue New York, NY 10016 212-573-8700
Air Conditioning & Refrigeration Institute 1815 Fort Myer Drive Arlington, VA 22209 703-524-8800	Electric Council of New England One Vinebrook Park Burlington, MA 01803 617-275-0310
American Gas Association Film Librarian 1515 Wilson Boulevard Arlington, VA 22209 703-524-2000	Exxon Corporation Public Affairs Department 1251 Avenue of the Americas New York, NY 10020 212-398-3000
American Petroleum Institute 2101 L Street NW Washington, DC 20036	General Electric Company Educational Films 60 Washington Avenue Schenectady, NY 12305 518-385-3875
Atomic Industrial Forum, Inc. 475 Park Avenue South New York, NY 10016 212-725-8300	Minnesota Power & Light Company 30 West Superior Street Duluth, MI 55802 218-722-2641
Brooklyn Union Gas Company Film Department 195 Montague Street Brooklyn, NY 11201 212-643-2000	Pacific Power & Light Company Public Service Building Portland, OR 97204 503-243-1122
Caterpillar Tractor Company 1687 Elmhurst Road Elk Grove Village, IL 60007 312-593-3250	Pennzoil Company 900 S.W. Tower Houston, TX 77002 713-236-7878
Portland General Electric Co. 621 S.W. Alder Portland, OR 97204 503-226-8517	Shell Film Library 1433 Sadlier Circle W. Drive Indianapolis, IN 46239 317-291-7440

IV. You can get a catalogue of free-rental films from the U.S. Department of Energy, Energy Film Library, Technical Information Center, PO Box 62, Oak Ridge, TN 37830 (614) 483-8611, Ext. 34161. Ask for their free film catalogue!

V. Major Governmental Energy Film Sources

Bonneville Power Administration
Department of Interior
1002 N.E. Holladay
Portland, OR 97208
503-234-3361

Department of Energy
Film Library
P.O. Box 62
Oak Ridge, TN 37830
615-483-8611 X3-4161

Environmental Protection Agency
1234 S.W. Morrison
Portland, OR 97207
503-221-3250

U.S. Department of Interior
Bureau of Reclamation
Engineering Research Center
P.O. Box 25007
Denver, CO 80225
303-234-3000

U.S. Department of Commerce
1220 S.W. 3rd
Portland, OR 97207
503-221-3001

* Check the U.S. Department
of Commerce in your area.

Film Services
Tennessee Valley Authority
Knoxville, TN 37902

VI. For the free loan of the films ENERGY TO BURN and TRAGEDY OF THE COMMONS (both excellent for classroom discussion), write to C. Richard Tillis, Director, Florida Office of Environmental Education, Knott Building, Tallahassee, FL 32301 (904) 488-6547.